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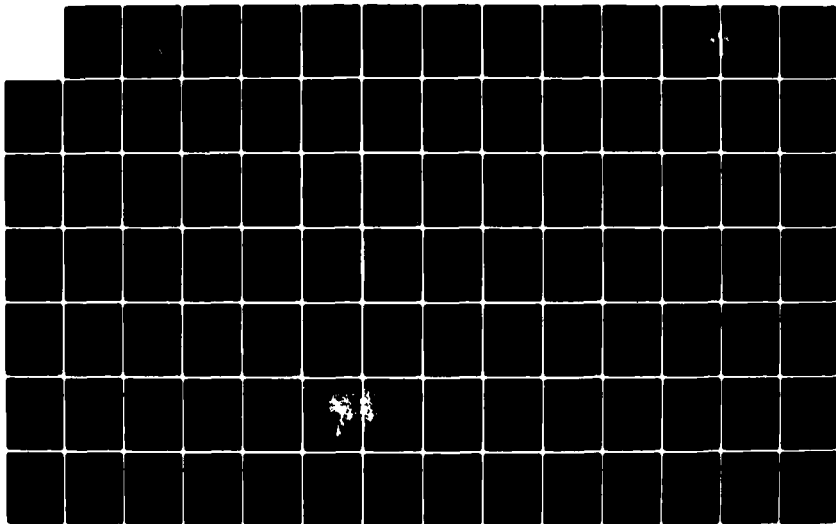
ASSESSMENT OF THE FLOOD PROBLEMS OF THE TAUNTON RIVER
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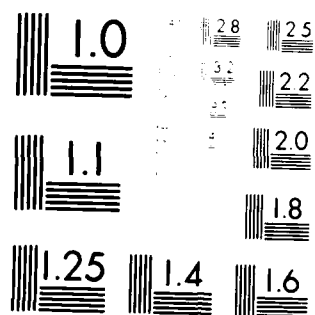
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PAWCATUCK RIVER AND
NARRAGANSETT BAY DRAINAGE BASINS

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Assessment of the Flood Problems

of the Taunton River Basin

in

Massachusetts

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DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Purpose of study is to investigate the flooding problems and other water resources needs within the Taunton River Basin and to develop a plan of improvements for resolving these problems. The selected plan includes regulatory measures only. Includes findings of a reconnaissance study which indicated those portions of the basin which are prone to urbanization and have greatest impact on increasing flood runoff.		

**PAWCATUCK RIVER AND
NARRAGANSETT BAY DRAINAGE BASINS**

**ASSESSMENT OF THE FLOOD PROBLEMS
OF THE
TAUNTON RIVER BASIN
MASSACHUSETTS**

SECTION A The Study and Report

**SECTION B Resources and Economy
 of the Study Area**

**SECTION C Flood Problems and Flood
 Management Needs**

SECTION D Formulating a Plan

SECTION E The Selected Plan

***DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.***

This plan was developed as part of a Congressionally authorized study to determine where, if any, Federally-funded flood control projects were justified. There are no existing major flood problems in the Taunton River Basin and consequently there is currently no need for any Federal projects. However the basin is in the Boston-Washington megalopolis corridor where further development is imminent.

The selected plan, which includes regulatory measures only, along with all available data on flood problems and plan formulation have been included in this report and will be available to the communities. This report should be utilized by the communities within the Taunton River Basin to minimize adverse effects of development and may some day be concerned with other studies or actions pertaining to flood management in the Taunton River Basin.

Section C (Flood Problems and Flood Management Needs) identifies the flood problems in the Taunton River Basin placing them in perspective in terms of local and regional significance. This section should be a guide to local communities in making planning and permitting decisions.

The plan formulation section (Section D) contains a discussion of the process used primarily to determine the need for a Federal project; however, it is also useful to communities in describing the effectiveness of the various flood management measures in different situations.

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SECTION A

The Study and Report

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PURPOSE AND AUTHORITY

The purpose of this study is to investigate the flooding problems and other water resources needs within the Taunton River Basin and to develop the most suitable plan of improvements for resolving these problems. Economic feasibility was one of the major factors considered in selecting a plan. The recommendations of this study are presented in Chapter E, "The Selected Plan."

Authority was given by a Senate Resolution adopted 3 May 1967 to review the Blackstone River, Massachusetts and Rhode Island in the interest of flood control and allied purposes. The 29 March 1968 resolution and five separate resolutions were adopted by the U.S. Senate and House of Representatives with particular reference to the Pawcatuck River and Narragansett Bay Drainage Basins. The seven outstanding resolutions have been combined in this study. The following are the resolutions that pertain to the Taunton River Basin:

Resolution adopted on 28 May 1968 by the Committee on Public Works of the United States Senate:

"That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report on Land and Water Resources of the New England-New York Region, transmitted to the President of the United States by the Secretary of the Army on April 27, 1956, and subsequently published as Senate Document Numbered 14, Eighty-fifth Congress, with a view to determining, in light of the heavy damages suffered during the storm of March 1968, in southern New England, the advisability of improvements in the Taunton and its tributaries, including the Mill River, Massachusetts, in the interest of flood control and allied purposes. "

Resolution adopted on 10 July 1968 by the Committee on Public Works of the House of Representatives, United States:

"That the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on Land and Water Resources of the New England-New York Region, transmitted to the President of the United States by the

Secretary of the Army on April 27, 1956, and subsequently published as Senate Document Numbered 14, Eighty-fifth Congress, with a view to determining, in light of the heavy damages suffered during the storm of March 1968, in southern New England, the advisability of improvements in the Taunton River and its tributaries, including the Ten Mile River and the Mill River, Massachusetts, in the interest of flood control and allied purposes."

SCOPE OF THE STUDY

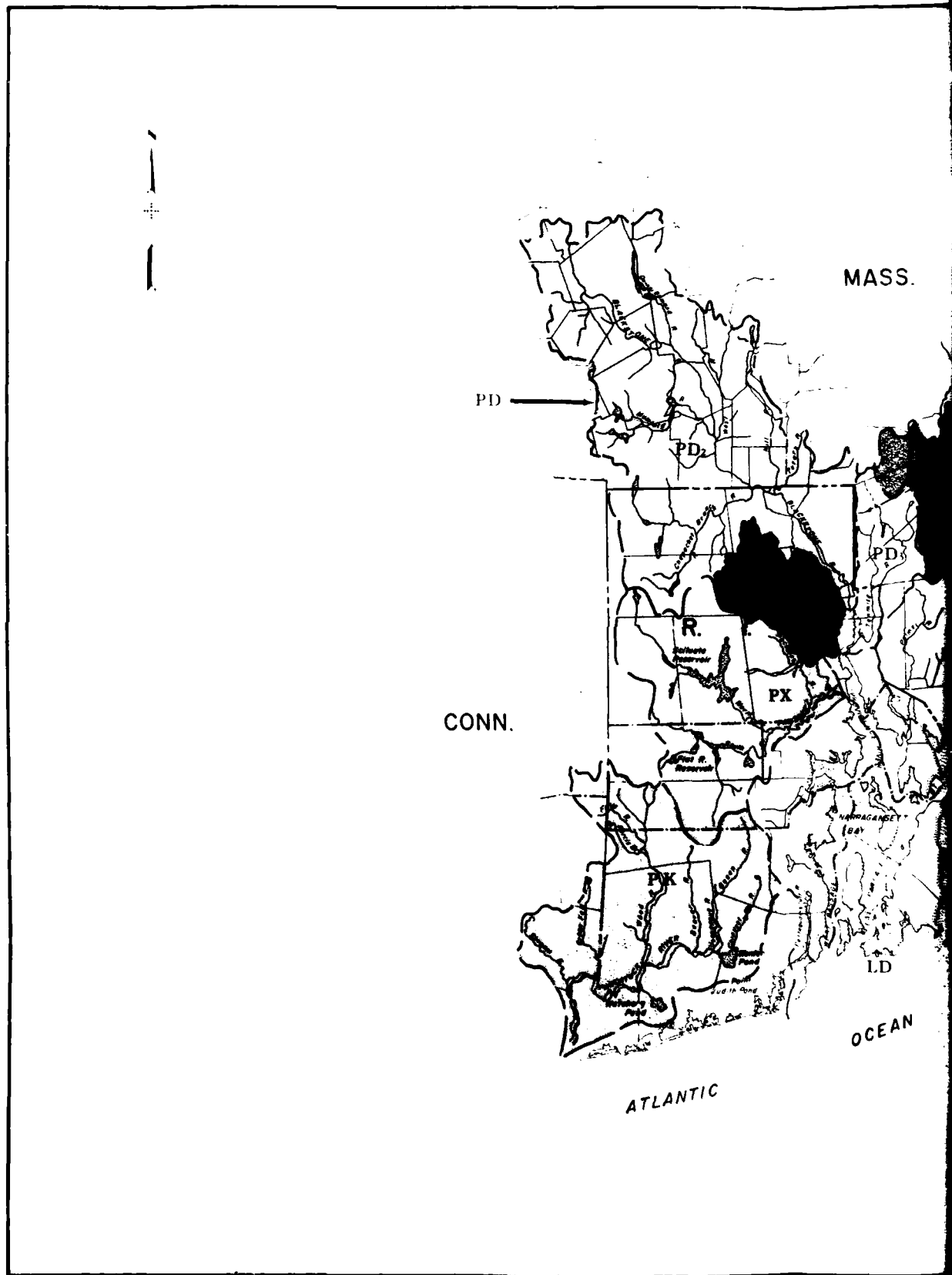
This report presents the results of a one year study of the water resource problems in the Taunton River Basin, one of five major watersheds in the Pawcatuck River and Narragansett Bay Drainage Basins (PNB) Study. Its purpose was to determine the advisability of improvements in the interest of flood control and allied purposes. A map showing the relationship of the Taunton River Basin and the PNB study area follows as Plate A-1. All reasonable alternative plans to solve the area's water resource problems were considered, and several protection schemes were studied in detail that included cost and benefit estimates. Selection of the most feasible plan was made after considering all factors, including comments expressed by concerned agencies and local interests. The studies were made in the depth and detail needed to permit plan selection and determine its feasibility.

The remainder of the river basins included in the authorizing resolutions were considered in separate feasibility studies.

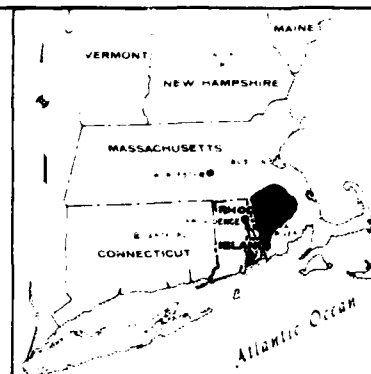
STUDY PARTICIPANTS AND COORDINATION

The New England Division, Corps of Engineers, had the principal responsibility for conducting and coordinating the study and the plan formulation, consolidating information from studies by other agencies and preparing the report.

Four initial public meetings were held in May 1969 for the PNB Study. These meetings were held in Taunton and Uxbridge, Massachusetts and Providence and Kingston, Rhode Island. These meetings were



MASS



LOCATION MAP

TAUNTON RIVER BASIN

LEGEND

- COMMUNITY BOUNDARY
- COUNTY BOUNDARY
- STATE LINE
- RESPECTIVE BASIN LIMITS
- PX PAWTUCKET RIVER BASIN
- TN TAUNTON RIVER BASIN
- PK PAWCATUCK RIVER BASIN
- LD LOCAL DRAINAGE
- PD PROVIDENCE RIVER GROUP WATERSHED
- PD₁ WOONASQUATUCKET - MOSHASSUCK - PROVIDENCE RIVERS SUB-BASIN
- PD₂ BLACKSTONE RIVER SUB-BASIN
- PD₃ TENMILE - SEEKONK RIVERS SUB-BASIN

SCALE IN MILES



WATER RESOURCES MANAGEMENT REPORT

PAWCATUCK RIVER AND
NARRAGANSETT BAY STUDY

BASIN MAP

DEPARTMENT OF THE ARMY
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WALTHAM, MASS

held to give local interests the opportunity to express their needs and desires, to exchange information concerning the study and to comment on some of the possible plans that could be considered. Subsequent to those meetings, informal meetings were held with State and municipal interests. Informal contacts with key Federal and State agencies and local contacts also furthered the progress of the studies.

THE REPORT

This report has been arranged into two separate documents: a main report and a technical appendix.

The main report is a nontechnical presentation of flood and associated water resource problems. It is the basic document, presenting a broad view of the overall PNB study for the benefit of both general and technical readers. It contains study findings of the pertinent portions of the remaining PNB watersheds: the Providence River Group, with the exception of the Blackstone Basin which is covered under a separate report; the Local Drainage to Narragansett Bay; the Pawcatuck River and the Taunton River. The Pawtuxet River was also previously covered in a separate study.

The main report describes the study area and existing improvements; the problems being experienced and the needs for additional improvements. It summarizes project economics and costs the plan formulation process used during the study and gives recommendations for implementing the selected plan.

In addition, the main report will include the findings of a reconnaissance study which indicated these portions of the basin which are most prone to urbanization and which will have the greatest impact on increasing flood runoff. The resulting flood management plan for the Taunton Basin will consist of National Flood Insurance and preservation of natural valley storage by non-Federal interests. State interests have indicated the need for study of water supply problems and navigation.

The technical report follows the same general outline as the formulation and evaluation portion of the main report. It is, however, more detailed and is written primarily for the technically oriented reader. It also focuses only on the Taunton River Basin. Development of the problems and solutions are presented in the same order as in the main report.

PRIOR STUDIES AND REPORTS

NARRAGANSETT REPORT

A report by the New England-New York Inter-Agency Committee (NENYAC), referenced in the preceding authorizing resolutions, was completed in March 1951. It presented an inventory of resources affected by streamflow regulation, water supply, water quality, flood control, hydroelectric power, navigation, shore erosion, fish and wildlife, recreation, historical sites, land management, mineral production and insect control. The report stated that the Taunton River does not have any history of destructive floods. Part One (introductory) and Chapter I of Part Two (general discussion) of the report have been published as Senate Document No. 14, 85th Congress, 1st Session. Chapter XVII of Part Two, "Narragansett Bay Drainage Basins." They discuss the resources of the Pawtuxet, Blackstone and Taunton watersheds and local drainage into Narragansett Bay and the Sakonnet River.

NAVIGATION SURVEY REPORTS

Taunton River Harbor - in response to a resolution by the House of Representatives, a report was prepared in September 1929 by the New England Division and was modified in 1946, 1954 and 1968. Within the Taunton Basin the project called for a channel 40 feet deep and 400 feet wide from deepwater in Mount Hope Bay northeasterly to the wharves below the bridges. The channel was to have increased widths at the bends and a turning basin 40 feet deep, 1,100 feet wide and 850 feet long between the Shell and Montaup wharves located on the Taunton River. The project required alteration of the Brightman Street Bridge to provide a clear channel width of 300 feet through the downspan and construction of a channel 30 feet deep and generally 300 feet wide to extend about one mile below Slades Ferry Bridge, east of the main harbor channel. All work listed above has been completed. However, portions of the work authorized by the modification in 1968 have not yet been completed. They are not within the Taunton River Basin.

Taunton River - in response to a resolution by the House of Representatives, a report was published in March 1930 and subsequently modified in June 1948 by the New England Division. It provided for a

channel 12 feet deep and 100 feet wide up to the Taunton municipal wharf, dredging of a turning basin 12 foot deep and 200 feet wide at a site about 2,300 feet below that wharf and dredging of a small craft anchorage eight feet deep and four acres in area in Dighton. Construction of the 12-foot channel to Peters Point was finished in 1940. To complete the project, there remains the deepening of the channel from Peters Point to the Taunton municipal wharf, the 12-foot deep dredging of the turning basin and the 8-foot deep dredging of the anchorage. The completed channel constitutes about four of the nine miles originally authorized. The 1948 River and Harbor Act required local interests to make a cash contribution toward the 12-foot turning basin and 8-foot anchorage and to provide a suitable wharf near the anchorage and another at the head of the channel. Federal funds have not been appropriated to complete the project, partly because local interests were not ready to meet the local participation requirements. The cost to complete the project was estimated in 1957 to be \$2,037,000, with \$1,000,000 to be contributed by local interests.

In 1958 the uncompleted work was placed in an inactive status as there was no evidence that the project would be used by commercial navigation if it were completed. Reactivation of the project would be contingent upon submission of data to support justification of the project as well as a strong indication that the requirements of local cooperation would be met.

NARRAGANSETT BAY AREA HURRICANE SURVEY REPORTS

In response to Public Law 84-71 study authority, which was adopted following the damaging hurricanes of 31 August and 11 September 1954, an interim report was completed in August 1957 by the New England Division (NED), Corps of Engineers. This report led to the 1958 authorization and 1961-66 construction of the Fox Point Hurricane Barrier across the upper reach of the Providence River at Providence.

A plan for hurricane tidal flood protection for the Narragansett Bay area, known as the Lower Bay Barriers, was completed in January 1965 by NED. The report entailed the provision of rockfill barriers (top elevation 25 feet mean sea level (msl) across the East and West Passages to Narragansett Bay and across the upper passage of the Sakonnet River, subject to local agreement to participate in the project. Ungated navigation openings would be provided at each passage and 80 sluice gates could normally remain open to allow additional tidal inter-

change. If in place at the time of the September 1938 hurricane flood, the barriers would have reduced the tide (stillwater) level of 13.7 feet msl to 6.9 feet at Fall River.

A majority of the comments made at the 1956 public meeting on the Fox Point Barrier project expressed general approval of the lower Narragansett Bay protection concept, and support by Massachusetts interests continues strong during the course of the Narragansett Bay Study. However, support by Rhode Island citizens waned and opposition grew because of various biological, aesthetic, tidal interchange, water quality, salinity and navigation aspects of the Lower Bay Barriers plan. In view of this lack of support, the Secretary of the Army's report to the Congress recommended that no project be authorized for the Lower Narragansett Bay area until such time that Rhode Island citizens expressed approval of the project.

NEWS STUDY FEASIBILITY REPORT

Under the authority of the 1965 Flood Control Act, the Corps of Engineers' North Atlantic Division directed a regionwide assessment of water supply problems of the metropolitan areas between Maine and Virginia. This was conducted as part of the Northeastern United States Water Supply Study. A draft report was then prepared by the New England Division in November 1969 concerning long range water supply needs in Rhode Island and most of Massachusetts. Two surface water projects were proposed for the Taunton River Watershed. The first project was proposed by the Corps and entitled "Potential Projects for 1990 Water Needs -- Taunton River Diversion to Lakeville Ponds; Taunton River Diversion to Copicut Reservoir" (an out of basin transfer). The second was a potential project for 2020 Water Needs -- Taunton River Estuary Dam, a proposal submitted by Tippetts-Abbett-McCarthy and Stratton Consulting Engineers in their report, "Regional Study for Water Supply, Sewage Disposal and Drainage, Southeastern Massachusetts Phase II. It was written in April 1969, for the Southeastern Massachusetts Regional Planning District. No groundwater projects were proposed for the Taunton Watershed area by the U. S. Geological Survey, who analyzed all existing groundwater reports as their contribution to the study.

NORTH ATLANTIC REGIONAL WATER RESOURCES STUDY

Authorized by the 1965 Flood Control Act, the North Atlantic Regional Water Resources (NAR) Study was one of 20 regional studies conducted throughout the United States under level A guidelines⁽¹⁾ established by the Water Resources Council. Published in June 1972 by the Corps of Engineers, North Atlantic Division, the report encompassed all river basins draining into the Atlantic Ocean from Maine to Virginia and all New York and Vermont areas draining into the Saint Lawrence River from St. Regis, New York eastward. The objective was to establish a broad master plan or framework for regional water and related land resources management. Fifteen water resource needs in each of the 21 subregions of the NAR study area were projected through the year 2020 according to several alternative planning objectives: environmental quality, national efficiency (or income), regional development or mixed objectives. A basic finding for the entire study area was that NAR water resources cannot support continuation of customary practices of increasing development and consumption. Research, study and management of water and land and environmental resources are needed to reduce the needs for excessive monetary and natural resource investments.

The report indicated that the PNB area will need help in eliminating its unemployment. Its water resource management program should be oriented toward increasing regional development, but with some environmental quality constraints. Key long-term (2020) needs for the PNB area are: water quality management and improvement to meet State standards, availability of power plant cooling water (mostly salt water sites), water supply withdrawal and importation measures (with future shift expected by many industries from self-supplied to publicly supplied systems), flood damage reduction measures as land becomes scarce, commercial navigation improvements, shore erosion protection for selected sites and increased opportunities for water oriented recreation, fish and wildlife recreation and recreational boating.

PRESERVATION OF NATURAL VALLEY STORAGE IN THE TAUNTON RIVER BASIN

This preliminary reconnaissance report was prepared by CME Associates for the Corps of Engineers in September 1975. The primary purpose of the study was to develop preliminary recommendations with respect to the preservation or acquisition of natural valley storage in the Taunton River Basin. The main conclusions arrived at are as follows:

- (1) Level A: Framework Studies and Assessments which evaluate the water and related land resources problems and needs on a broad regional basis and identify regions with problems which require detailed study.

With the existing natural valley storage and the level and location of development, flooding in the basin is not a severe problem. The existing natural valley storage provided by the numerous wetlands contributes in a major way to the control of storm flows. The northern areas of the basin will experience the most development pressure, but the existing regulatory and management programs to protect the storage function of the wetlands are adequate if they are effectively managed.

WATER QUALITY MANAGEMENT PLAN FOR THE TAUNTON RIVER BASIN

This report was prepared by the Commonwealth of Massachusetts as part of the requirement of Section 303 (e) of the 1972 Federal Water Pollution Control Act, as amended. Several other reports were also prepared by the Commonwealth and their pertinent findings are included in this report. A mathematical model was developed and applied in the upper Taunton River, the Threemile River and the Taunton River Estuary. Allowable loads for water quality segments and effluent allowable loads for municipalities and industries were calculated. When implemented through appropriate wastewater treatment methods, water quality will be greatly improved.

SOUTHEASTERN NEW ENGLAND (SENE) REPORT

As part of the program established by the 1965 Water Resources Planning Act that multiple-purpose, coordinated plans would be developed for each subregion or major river basin in the Nation, a comprehensive level B study of the coastal basins of eastern Massachusetts, Rhode Island and the southeastern corner of Connecticut was authorized by the Water Resources Council. Under the direction of the New England River Basins Commission (NERBC), a Federal-State study team evaluated existing, 1990 and 2020 needs in the SENE area (including all of the PNB area), principally those concerning water supply, water quality, recreation, marine management, flooding and erosion, minerals extraction and the siting of electrical power and petroleum facilities. The report to the Water Resources Council, submitted in March 1976, indicated that continuing urban growth in the SENE area can be accommodated but should be guided to protect fragile resources and make development more efficient.

- (1) Level B: Reconnaissance level studies for a limited area which identify and recommend plans and programs to be pursued by Federal, State, and local entities and lead to subsequent implementation studies.

Key recommendations for meeting 1990 needs in the Taunton River Basin were protection of critical environmental areas that can be used extensively for such resources as water supply, fisheries and shellfish production, limited recreation and scenic or open space lands; restriction of growth on other not-so-critical environmental areas; management of growth on developable lands; creation of a regional water authority for the Taunton area to develop and plan both water supply and water quality management programs, with a first priority to investigate the diversion of water from Fall Brook in Lakeville to Assawampsett Pond; and development of a flood plain management program for the entire Taunton River basin. The SENE study efforts were closely coordinated with those of the PNB study.

The SENE Study recognized that specific project proposals were being evaluated by the PNB study to resolve the major flood problems in the lower basin. Therefore, the SENE study concentrated its recommendations on regulatory and conservation and forestry measures that all basin municipalities should adopt in the interest of reducing flood plain encroachment, erosion and nonpoint source pollution.

FLOOD INSURANCE STUDIES

Under the authority of the National Flood Insurance Act of 1968, Flood Insurance Study Reports have been or are being prepared for the Flood Insurance and Hazard Mitigation Office of the Federal Emergency Management Administration formerly (Federal Insurance Administration, Department of Housing and Urban Development (HUD)) for the communities listed on Table A-1. The status of these flood insurance reports is constantly changing. A flood hazard rate map is available for the community of Attleboro.

FLOOD PLAIN INFORMATION REPORTS

One Taunton Basin community, Holbrook, is having a flood plain information report prepared for their use by the Soil Conservation Service (SCS). The town of Easton has recently been furnished with the completed flood plain information report prepared by this office. A flood hazard analysis of specific streams within Attleboro is also currently under study by SCS. Additional new starts will not be made under this program due to a duplication of effort with the Flood Insurance Reports.

STUDIES IN PROGRESS

A water supply study including the Taunton River Basin has been initiated by the New England Division as part of the larger PNB Study. Conditions which generated the study include deteriorating quality of water supply in several major population centers, as well as, the failure of supplies to keep pace with development.

The study will provide information on the adequacy of existing water supplies to meet future residential, commercial, and industrial uses. In communities where existing water supplies prove to be inadequate, potential surface and groundwater sources will be reviewed to determine their ability to meet future municipal water requirements through the year 2020. Alternatives to accomplish this goal may be developed on a regional and/or local basis and shall contain structural and/or nonstructural measures.

At least one alternative shall make maximum contributions to National Economic Development (NED) and at least one alternative shall maximize enhancement of environmental quality (EQ). The water supply study has been completed and the report was distributed to the public officials in May 1979.

TABLE A-1

TAUNTON RIVER BASIN
FLOOD INSURANCE STUDIES
(as of December 1978)

<u>Town</u>	<u>Status</u>
Abington	Regular
Attleboro	Regular
Avon	Emergency
Bridgewater	Emergency
Brockton	Emergency
Dighton	Emergency
E. Bridgewater	Emergency
Easton	Emergency
Fall River	Emergency
Foxborough	Emergency
Freetown	Emergency
Halifax	Emergency
Hanson	Emergency
Holbrook	Suspended
Lakeville	Emergency
Mansfield	Regular
Middleborough	Emergency
Norton	Emergency
Plainville	Emergency
Raynham	Emergency
Sharon	Regular
Somerset	Regular
Stoughton	Emergency
Taunton	Emergency
W. Bridgewater	Emergency
Whitman	Emergency
Wrentham	Emergency

SECTION B

Resources and Economy of the Study Area

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ENVIRONMENTAL SETTING AND NATURAL RESOURCES

The Taunton River Basin, shown on Plate B-1, lies principally within southeastern Massachusetts with a small portion in eastern Rhode Island. It has a total drainage area of 570 square miles and outlets to Mount Hope Bay opposite Brayton Point in Somerset, Massachusetts. The lower 3 miles of the Taunton River is also known as Fall River Harbor. Approximately 28 miles of the river are tidal; and the river's watershed area upstream of normal tidal influence, above the city of Taunton, is about 300 square miles. Taunton is the largest basin in southeastern New England south of the Merrimack and east of the Thames.

Compared to most New England basins, the Taunton must be classified hydrologically as a very sluggish watershed due to its flat topography and the numerous swamps and ponds. These swamps effectively retard the runoff from their surface areas as well as from their contributing watersheds. Therefore, they contribute very little to downstream flood peaks except for a relatively uniform base flow. Some notable detention areas include the Hockomock Swamp, the Lakeville Pond complex and North and South Watuppa Ponds. A number of small storage reservoirs for industrial and municipal water supply purposes also are present.

The largest source of domestic water supply within the basin is the Lakeville Ponds complex made up of 5 interconnected ponds that drain into the Nemasket River, a tributary of the Taunton. The 5 ponds -- Long, Asawompset, Pocksha and Great and Little Quittacas -- have a total drainage area of 47.2 square miles and a total usable capacity of 11,197 million gallons based on a maximum yield of 34 million gallons per day (mgd) based on analysis of the critical drought of the 1960's. Tables B-1 and B-2 list the significant water bodies and wetlands which are within the basin. The swamps with a surface area of 500 acres or larger are shown on Plate B-2.

The Taunton River Basin, although in the path of the Boston-Washington megalopolis, is not, as yet, highly developed. This fact alone is one of the reasons why flood problems in the basin have not yet become major. There are presently only 3 cities in the basin with populations over 35,000 -- Fall River, Taunton and Brockton. With new major highways through the area, however, the region is experiencing the pressures of both residential and industrial expansion. The current

TABLE B-1

TAUNTON RIVER BASIN
PRINCIPAL WATER BODIES

<u>Name</u>	<u>Approximate Surface Area (acres)</u>	<u>Natural/Manmade</u>
Assawompset & Pocksha Ponds	2,700	Natural
North Watuppa Pond	1,800	Natural
Long Pond	1,750	Natural
South Watuppa Pond	1,550	Natural
Great Quittacas Pond	1,150	Natural
Norton Reservoir	600	Manmade
Stafford Pond	500	Manmade
Monponset Pond	500	Natural
Lake Nippenticket	400	Natural
Sawdy Pond	400	Natural
Little Quittacas Pond	300	Natural
Lake Sabbatia	250	Manmade
Tispaquin Pond	190	Natural
Somerset Reservoir	160	Manmade
Cook Pond	160	Manmade
Winnecunnet Pond	150	Natural
Leach Pond	135	Natural
Robbins Pond	130	Manmade

TABLE B-2

TAUNTON RIVER BASIN
SIGNIFICANT WETLANDS

	Approximate Area (acres)
Hockemock Swamp	7,500
Great Cedar Swamp (Middleborough)	1,400
Great Cedar Swamp (Hanson)	1,200
Cedar Swamp River	1,100
Black Brook (Middleborough)	800
Turkey Swamp	750
Hemlock Swamp	735
Bolton Cedar Swamp	700
Canoe River	700
Cotley River	600
Pine Swamp	560
Charley Brook	550
Ball Brook	490
Meetinghouse Swamp	470
Purchase Brook	400
Peterson Swamp	400
Titicut Swamp	350
Black Brook (Easton)	350
Pocasset Cedar Swamp	340
Dead Swamp	300

accelerated development makes it increasingly important to preserve the large swamp retention areas and halt further encroachment upon the floodplains if the basin is to retain its hydrologic character and future flood problems are to be minimized.

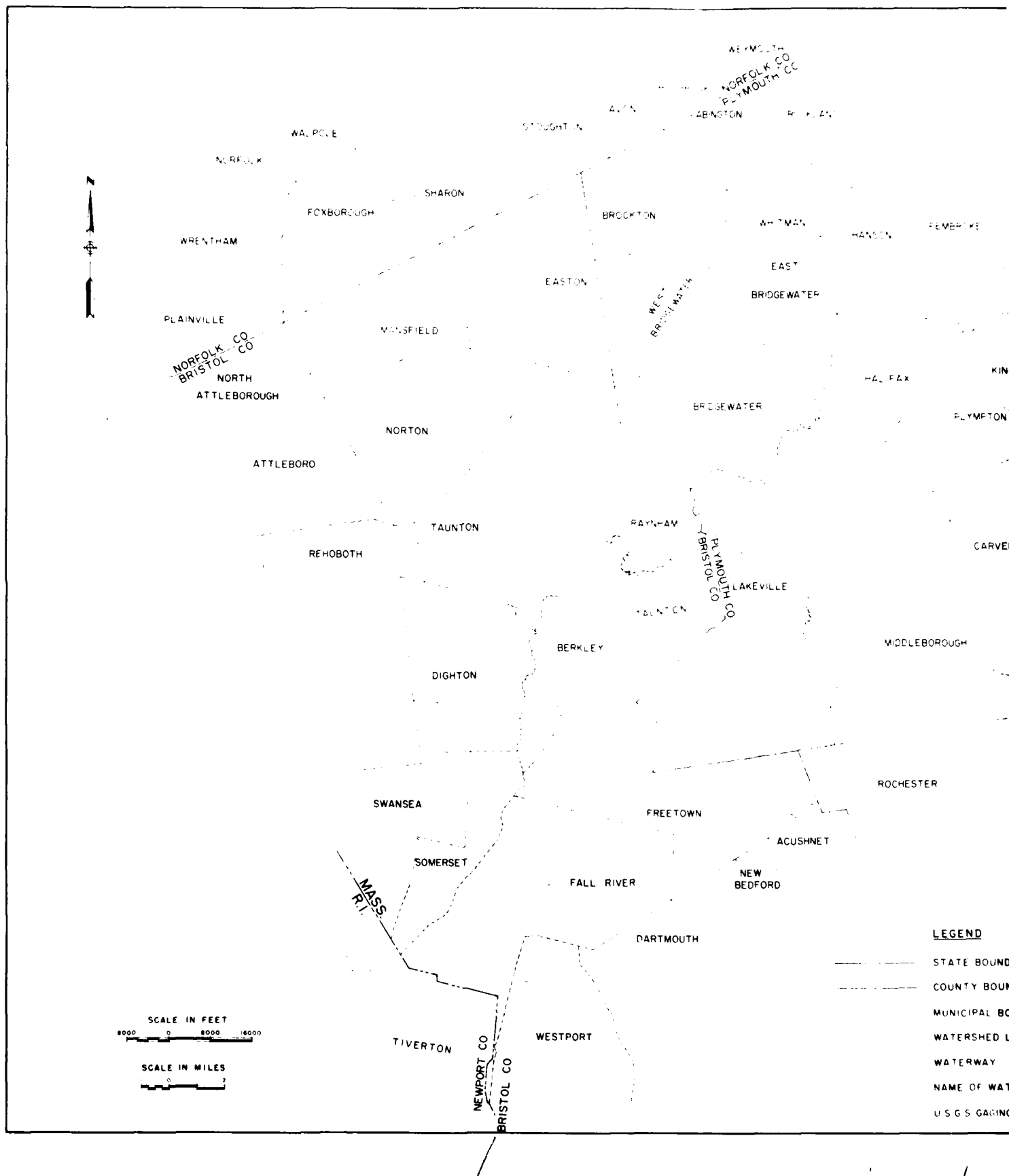
With its flat topography and swampy character much of the watershed has a relatively high groundwater table, and water is a relatively abundant resource in the region. For this reason, cranberry bogs are one of the principal agricultural crops in the region.

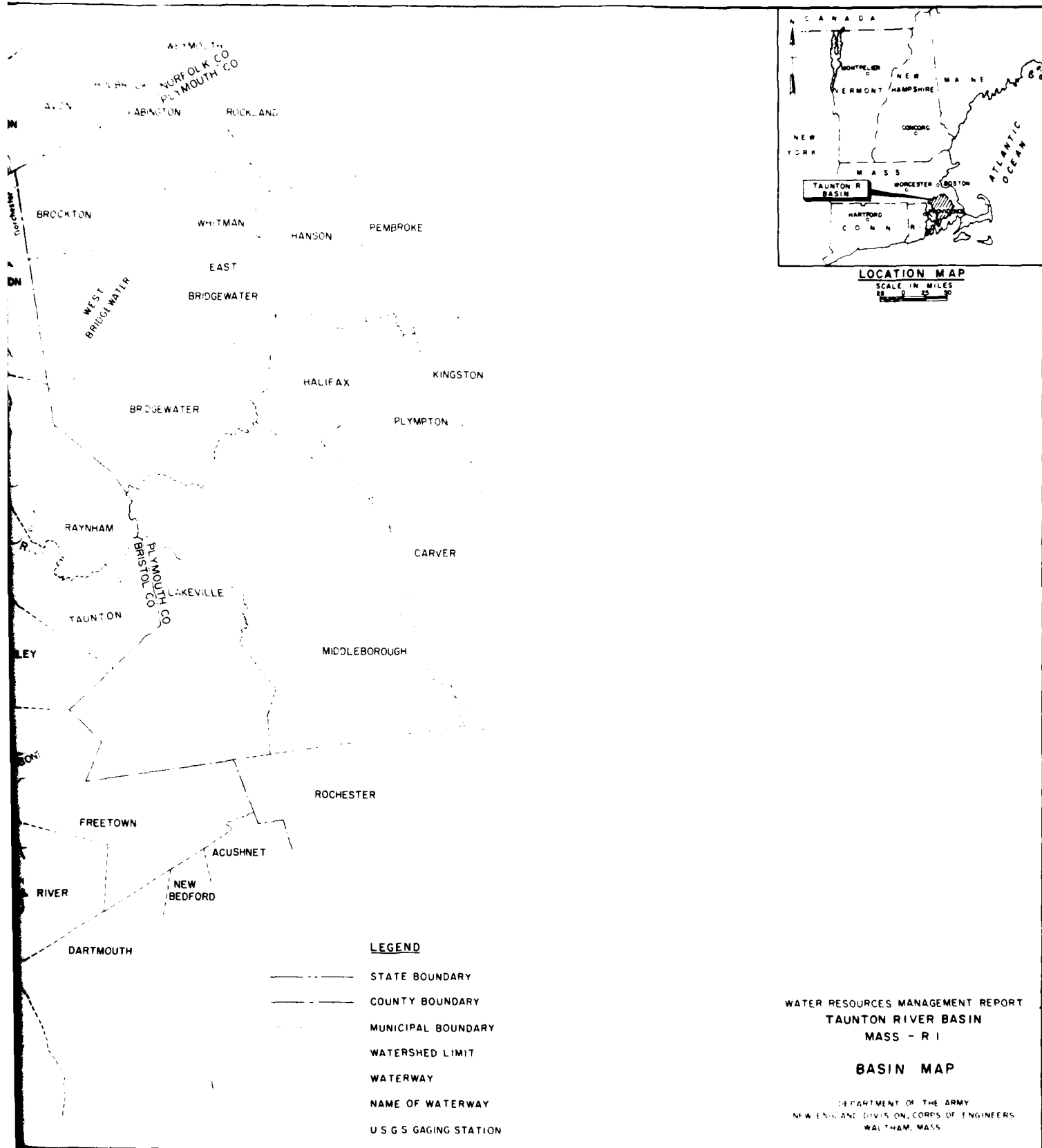
Most domestic and industrial water is obtained from individual groundwater and/or small surface water sources. The city of Taunton has a regional source, the Lakeville Ponds, while Brockton obtains its water mainly from Silver Lake, located just outside of the Taunton River Basin. Fall River, largest city in the basin, obtains its water from North Watuppa Pond. In years past this was supplemented by diversion from Lake Noguchoke outside the basin. More recently, however, due to poor quality of the lake water, a reservoir has been constructed on the Copicut River, and it is being used during periods of maximum demand.

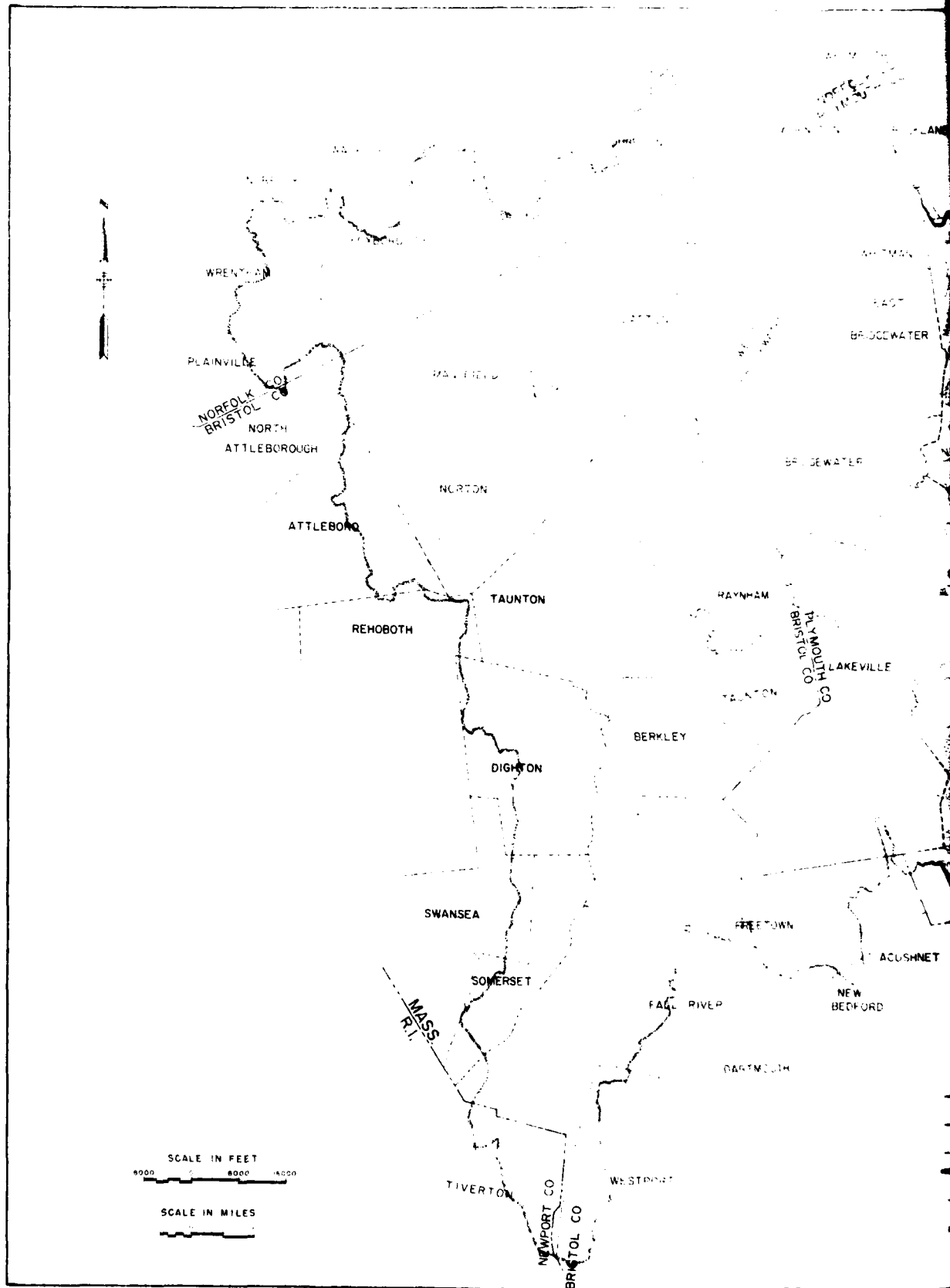
PRINCIPAL STREAMS OF THE BASIN

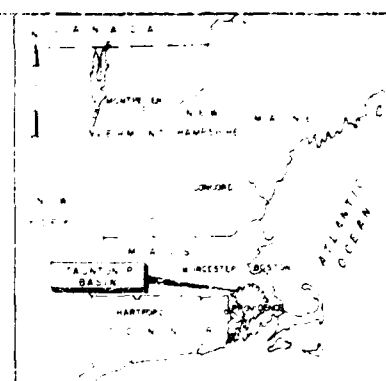
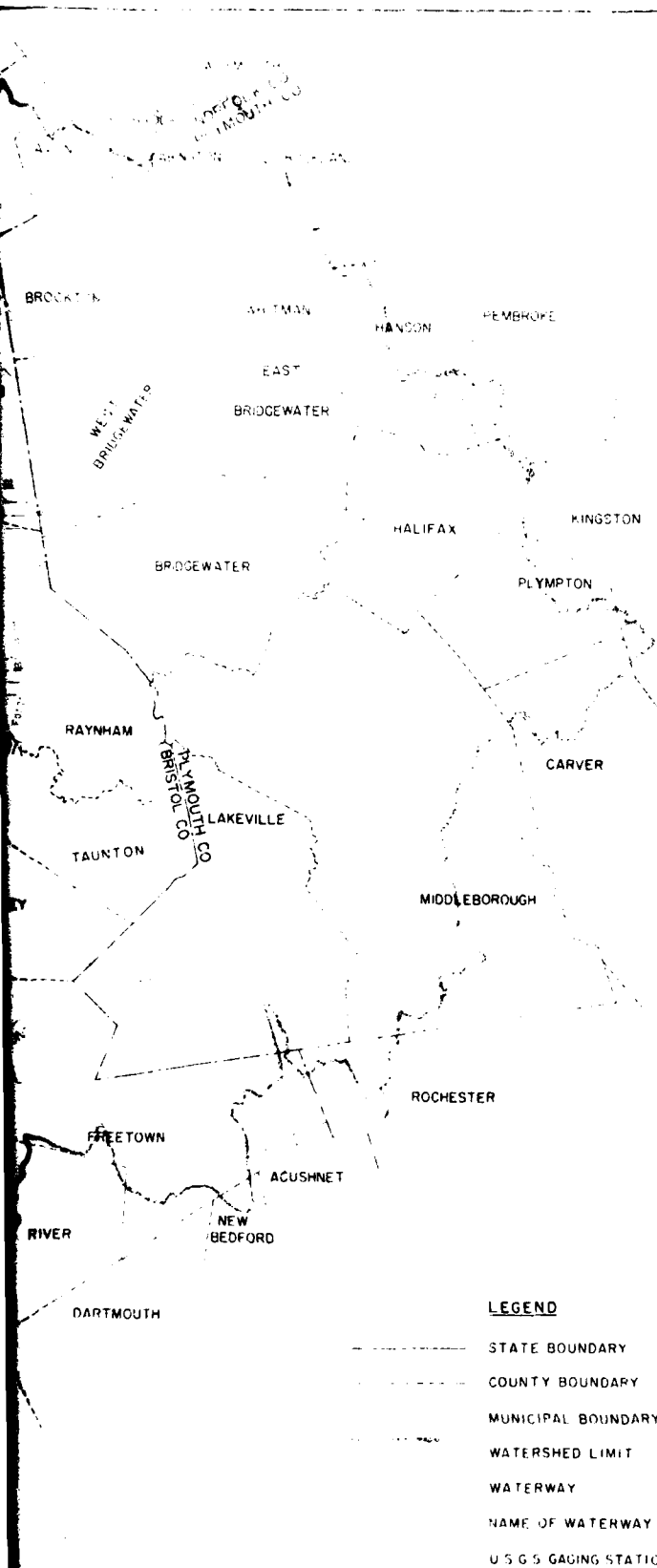
Taunton River - The Taunton River is formed by the confluence of the Town and Matfield Rivers approximately 1.7 miles east of the center of Bridgewater. In addition to these streams which form the Taunton River at river mile 38.2, the Taunton is joined by six other major tributaries -- the Winnetuxet River at river mile 30.8 in Middleborough, the Mill River at river mile 16.3 in Taunton, the Threemile River at river mile 12.7 inighton-Taunton, the Assonet-Cedar Swamp River at river mile 6.8 in Freetown-Berkeley and the Quequechan River at river mile 1.1 in Fall River. The Taunton meanders first in a southeasterly and then in a southwesterly direction until it reaches Mount Hope Bay. The reach of the river above the State Farm flow gaging station, located in Bridgewater until 1976, is relatively flat, with a drainage area at the gage of 260 square miles. An estimated 17 percent or 44 square miles of this drainage is swamp or wetland. These wetlands tend to have a retarding effect on runoff from the upper watershed, with the swamps acting much like flood control reservoirs.

About 23 miles of the Taunton River, up to East Taunton, can be influenced by normal tidal fluctuations. The tidal surge varies from 4.4 feet at Brayton Point to 2.8 feet at Taunton, 15 miles upstream. Small









LOCATION MAP
SCALE IN MILES
25

NAME OF SWAMP

- 1 HOCKOMOCK SWAMP
- 2 GREAT CEDAR SWAMP
- 3 GREAT CEDAR SWAMP
- 4 CEDAR SWAMP RIVER
- 5 BLACK BROOK
- 6 TURKEY SWAMP
- 7 HEMLOCK SWAMP
- 8 BOLTON CEDAR SWAMP
- 9 CANOE RIVER
- 10 COTLEY RIVER
- 11 PINE SWAMP
- 12 CHARTLEY BROOK

LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- WATERSHED LIMIT
- WATERWAY
- NAME OF WATERWAY
- U S G S GAGING STATION

WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS. - R.I.

MAJOR WETLANDS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

draft vessels can navigate up to the confluence with the Mill River, while larger vessels can navigate only up to the power plant and oil farm in Somerset, some 3.5 miles upstream.

The topography along the upper portions of the Taunton River can best be described as lowlying. Along this reach, most of the land lies only a few feet in elevation above the adjacent flood plain. These areas contain many marshlands which spawn or feed the local streams. From the city of Taunton downstream to the mouth, the river's floodplain is so wide it can be covered by very high hurricane surges, despite being some 15 to 20 miles inland. However, its adjacent lands tend to rise much more sharply than the upstream reaches. The local drainage to the Taunton River -- the area not drained by any of the eight major tributaries -- accounts for about 133 square miles or slightly less than 25 percent of the total drainage of the entire basin.

The lands adjacent to the Taunton River have not been altered by man for the most part, although exceptions are found along the river segments in Fall River, Somerset, Taunton and Raynham.

During normal flow the Taunton River falls about 22 feet and has an average slope of only one-half a foot drop per mile in length. There are no man-made obstructions along the Taunton River from its mouth up to river mile 38.0, where a small dam has been built at Paper Mill Village in East Bridgewater. Downstream of the dam, the river averages between 75 feet and 100 feet in width, gradually widening as it flows downstream. At Brayton Point, the river is about 1.1 miles in width.

Town River - The Town River watershed has a drainage area of 60.1 square miles and is located in the north central portion of the Taunton River Basin. It has its beginning in the headwaters of Dorchester and Queset Brooks, located in Stoughton and Easton. The watershed is characterized topographically by hills and lakes in the upper portions and extensive swampy lowlands in the lower reaches.

The basin has experienced little development other than several villages in Easton, Bridgewater Center, West Bridgewater Center and portions of Brockton and South Stoughton. These developments have been built on high parcels of land. Future development from the lower portions of the basin should be minimal, due in part to high water tables and low lying land.

The basin's predominant feature is Hockomock Swamp, which covers more than 6,500 acres. Virtually all of this land is owned by the Commonwealth of Massachusetts. It is the largest swamp in Massachusetts and possibly the largest in the northeastern States. The few man-made developments that have encroached on it are limited mainly to secondary road systems and a power line. Lake Nippenicket, a shallow pond about one-half square mile in area, is the largest body of open water remaining in the Hockomock. It is an extremely good producer of game fish. The Town River originates at this lake.

Matfield River - The Matfield River watershed covers 78.0 square miles of the northern-northeastern portion of the Taunton River Basin. It is the second largest subbasin in land area in the overall Taunton Basin, and it is the most urbanized. Its large populated sections include the city of Brockton and the centers of East Bridgewater, Rockland and Whitman.

Topographically, the sub-basin is of low relief with a high point only 220 feet above mean sea level (msl). There are numerous ponds in the upper watershed, especially along the Salisbury Plain River's tributaries. The Salisbury Plain River and Beaver Brook form the Matfield River, which is about 6 miles long.

Numerous small marshlands are scattered along the tributaries to the Matfield; only one, the Great Cedar Swamp, covers any appreciable area. Because of the urbanized nature of the subbasin, those marshlands unprotected by adequate conservation measures are the most likely to be filled for new development.

Winnetuxet River - The Winnetuxet River watershed forms the east central portion of the Taunton River Basin. Topographically, this sub-basin is also predominantly of extremely low relief with high elevations that are approximately 100 feet above msl. Total drainage area of this subbasin is 38.6 square miles, and it is characterized by many small cranberry bog operations, swamps and ponds. Only small isolated areas of the watershed have been modified by urban development. The population in this area is the smallest of all the subbasins that make up the Taunton.

Nemasket River - The Nemasket River watershed is the southeastern portion of the overall basin. It is characterized by a series of five large interconnected ponds: Assawompsett, Pocksha, Great Quittacas, Little Quittacas and Long. These ponds supply water primarily to the

city of Taunton and to New Bedford. Only one developed area, Middleboro Center, is within the confines of the watershed.

Topographically, the relief is not as low as that of the other sub-basins. However, water bodies and wetlands account for almost 30 percent of the basin's 69.1 - square mile drainage area.

Mill River - The Mill River watershed is a cigar-shaped drainage basin, 42.9 square miles in extent, that forms the central section of the Taunton River Basin. The Mill River rises in Lake Sabbatia to the north of the city of Taunton and is controlled by three dams along its course. Above Lake Sabbatia a few villages are scattered over topography that ranges from numerous swamps on the Canoe and Snake Rivers to hills higher than 300 feet msl. Numerous ponds and lakes and a portion of the Hockomock Swamp are located within the sub-basin. The actual drainage divide is dependent upon antecedent conditions in the swamps and the amount of runoff passing through it.

The banks along the Mill River itself are highly developed. In several locations buildings have either severely encroached on the river or have been built right over it. This section of the river passes through the center of Taunton. Its lower reaches can be influenced by abnormally high tides and hurricane surges.

Threemile River - The Threemile River watershed is located in the northwest-western segment of the Taunton River Basin. It is the largest of the sub-basins, covering a drainage area of 80.3 square miles. The Threemile River is formed by the confluence of the Wading and Rumford Rivers. Urban development has occurred primarily in the upper segment of the sub-basin, although it is less urbanized than the others. Future growth has been projected for this area, however, mainly because of the interstate road systems.

Topographically, the upper area has numerous ponds controlled by man-made dams and it is similar in elevation to most of the other sub-basins as are the lower portions. The watershed's predominant feature is Norton Reservoir, which is used for emergency water supply and recreation.

Assonet River-Cedar Swamp

The Assonet River-Cedar Swamp watershed is a portion of the southeastern part of the Taunton River Basin. It has a total drainage area of 35.1 square miles. The Assonet changes to Cedar Swamp River, a

name it derives from the large swamp it drains, near the Freetown-Lakeville town line. Three dams control the flow of the river.

Topographically, this watershed has moderate relief where elevations at the drainage divide exceed 200 feet msl. Approximately 25 percent of the subbasin consists of ponds or wetlands.

Quequechan River - The Quequechan River Basin drains 32.3 square miles and has its source at South Watuppa Pond. A considerable portion of this river flows through a culvert system that bisects the city of Fall River. This watershed is the southern segment of the Taunton River Basin.

Almost 50 percent of the subbasin consists of marshlands or ponds. Two large ponds, North and South Watuppa, supply water to the city of Fall River. The remaining 50 percent is highly urbanized by some 100,000 inhabitants.

CLIMATOLOGY

a. General - The Taunton River Basin lies wholly within the southeastern New England region, a humid area with an average annual precipitation of about 44 inches. It has a variable climate characterized by frequent but generally short periods of heavy precipitation. Lying in the path of the "prevailing westerlies" it is exposed to cyclonic disturbances that cross the country from the west or southwest. This region is also exposed to two types of coastal storms that travel up the Atlantic seaboard -- hurricanes of tropical origin and storms of extratropical origin that are often called "northeasters." The temperature within the basin ranges from summertime highs in the 90's to subzero lows in the winter. Spring melt of winter snow usually occurs throughout most of the basin by March, with melting occasionally extending into early April in the northernmost interior sections.

b. Temperature- The mean annual temperature varies from about 50 degrees Fahrenheit (F) along the coast to 48 degrees F in the interior sections. Extremes in temperatures range from highs slightly in excess of 100 degrees F to lows in the minus 20's. Mean, maximum and minimum monthly temperatures at representative coastal and interior stations in and near the Taunton River basin are shown in Table B-3.

TABLE B-3
MONTHLY TEMPERATURE

Month	Blue Hills, Mass. 140 Years of Record			New Bedford, Mass. 87 Years of Record		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
January	25.2	68	-16	30.3	66	-11
February	25.6	67	-21	30.1	69	-12
March	33.5	85	-5	37.5	77	2
April	44.0	89	6	46.9	85	18
May	55.3	93	27	57.0	95	30
June	64.3	99	36	65.9	102	41
July	69.4	99	46	71.8	99	45
August	67.6	101	39	70.5	107	44
September	60.8	99	28	64.1	94	30
October	50.6	88	21	54.4	90	22
November	39.6	81	5	44.4	79	9
December	28.7	68	-19	33.7	66	-11
Annual	47.1	101	-21	50.6	107	-12

Month	Providence, R.I. 72 Years of Record			Taunton, Mass. 104 Years of Record		
	Mean	Maximum	Minimum	Mean	Maximum*	Minimum*
January	29.3	68	-13	27.1	68	-25
February	29.4	69	-17	27.8	69	-21
March	37.6	90	1	35.8	86	-11
April	47.6	98	11	45.8	89	10
May	56.5	95	32	56.5	93	23
June	67.0	101	39	65.5	99	32
July	72.7	101	49	71.1	100	30
August	71.0	104	40	69.2	102	32
September	63.8	99	32	61.9	98	25
October	53.9	90	20	51.7	86	14
November	43.2	82	9	41.1	80	2
December	32.6	69	-12	30.5	66	-22
Annual	50.1	104	-17	48.7	102	-25

*Maximum and minimum temperature data available only from 1922 to present.

c. Precipitation - The mean annual precipitation at Taunton, based on over 100 years of record keeping, is 45.36 inches. The greatest annual precipitation ever recorded at this station was 67.23 inches in 1889. Table B-4 summarizes the mean, maximum and minimum annual precipitation at selected recording stations in or near the basin.

d. Snowfall - Snowfall within the Taunton Basin is measured at Taunton. Annual snowfall at this station has averaged 37.4 inches over 21 years of record keeping. As a means of comparison, recorded snowfall at locations near the basin was investigated. Average annual snowfall was determined from approximately 50 inches near the coast to about 10 inches in the interior. Table B-5 summarizes the mean monthly snowfall at recording stations in and near the Taunton River basin.

e. Water Equivalent - Water equivalent of snow cover is recorded at various locations throughout New England by the Corps of Engineers. In this study, the closest recording site to the Taunton River basin is located in the Blackstone River basin about 50 miles northwest. Data listed in Table B-6 is considered applicable only to the most northern or northwest portions of the Taunton basin. Wide variation of water equivalent of snow cover can reasonably be expected as one travels from the interior to the coastal areas. Lack of a substantial snow cover near the coast is due to milder temperatures; annual snowfall is approximately half that experienced in the interior.

f. Storms - The rapidly moving cyclonic storms or "lows" that move inland are caused from the west or southeast produce frequent periods of variable though seldom extremely severe, weather. The regions most often exposed to coastal storms, some of tropical origin, that travel up the Atlantic coast. The worst storms, which occur, however, in late summer and early autumn, have been of tropical origin.

Six recent flood producing storms in the southeastern New England region occurred in March 1939, July 1953, September 1954, August 1955, October 1956, and March 1968. Hurricane "Diane" of August 1955 produced floods throughout much of southern New England. The accompanying rain fell on ground previously saturated by rainfall from Hurricane "Connie" which occurred a week earlier. The March 1968 storm was of lesser magnitude than the 1955 but occurred in the spring when antecedent conditions were high. This produced record flows in many southeastern New England streams.

TABLE B-4
MONTHLY PRECIPITATION

Blue Hills, Mass. 91 Years of Record Elev. 629 feet msl				New Bedford, Mass. 163 Years of Record Elev. 70 feet msl			
Month	Mean	Maximum	Minimum	Mean	Maximum	Minimum	
January	4.05	10.97	.89	3.89	10.75	0.77	
February	3.99	9.32	1.04	3.71	8.30	0.91	
March	4.31	10.96	.06	4.11	9.77	0.09	
April	3.87	8.71	.92	3.84	9.64	0.91	
May	3.60	9.16	.50	3.65	9.80	0.32	
June	3.48	10.78	.53	3.04	10.03	0.01	
July	3.52	11.67	.13	3.03	12.00	0.02	
August	4.05	18.78	1.22	3.47	18.72	0.24	
September	4.01	11.04	.45	3.40	12.06	0.21	
October	3.75	10.84	.22	3.62	10.09	0.15	
November	4.30	9.29	.63	4.08	9.74	0.35	
December	4.33	12.50	.92	4.07	11.70	0.45	
Annual	47.26	63.81	26.96	43.91	71.52	21.87	

Providence, R.I. 72 Years of Record Elev. 51 feet msl				Taunton, Mass. 102 Years of Record Elev. 20 feet msl			
Month	Mean	Maximum	Minimum	Mean	Maximum	Minimum	
January	3.63	7.12	0.50	4.14	9.93	0.61	
February	3.29	5.80	1.18	3.71	8.85	0.83	
March	3.70	8.31	0.07	3.98	8.92	0.05	
April	3.54	7.32	0.72	3.92	8.54	0.85	
May	3.13	9.25	0.57	3.28	10.39	0.25	
June	2.97	7.21	0.04	2.11	8.89	0.05	
July	2.43	8.08	0.24	3.59	9.89	0.12	
August	3.61	12.24	0.78	4.19	15.78	0.14	
September	3.35	9.79	0.48	3.66	11.63	0.02	
October	3.09	11.89	0.15	3.63	10.48	0.19	
November	3.69	8.50	0.31	4.18	9.25	0.41	
December	3.86	10.75	1.05	3.97	9.82	0.62	
Annual	40.29	65.06	25.44	45.36	67.23	27.31	

TABLE B-7

MEAN MONTHLY SNOWFALL
(Depth in inches)

Month	Black Hills, Mass. Fletcher Field 83 Years of Record	New Bedford, Mass. Fletcher Field 73 Years of Record	Provincetown, P.I. Fletcher Field 71 Years of Record	Long Beach, Mass. Fletcher Field 4 Years of Record
January	15.4	9.1	9.3	0
February	16.7	10.4	10.2	11.0
March	11.3	6.7	6.7	6.8
April	3.1	1.2	0.9	2.5
May	0.1	0.0	0.0	0
June	0.0	0.0	0.0	0
July	Trace	0.0	0.0	0
August	0.0	0.0	0.0	0
September	Trace	0.0	0.0	0
October	0.2	Trace	Trace	0
November	2.7	0.6	1.0	0.6
December	10.7	6.6	6.6	7.3
Annual	60.2	34.8	34.90	37.40

TABLE B-6
WATER EQUIVALENTS OF SNOW COVER
(Inches)

Blackstone River Basin
1957-1977

<u>Date</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>
1 Feb	0.0	1.6	3.9
15 Feb	0.0	2.1	5.2
1 Mar	0.0	2.3	6.0
15 Mar	0.0	1.7	5.0
1 Apr	0.0	0.5	3.3
15 Apr	0.0	0.0	0.7

TOPOGRAPHY

The Taunton River Basin is located in southeastern Massachusetts and includes a small part of Rhode Island. It lies within the Seaboard Low-land section of the New England Physiographic Province. The basin has an irregular topographic surface with a maximum elevation of approximately 450 feet, reached in the hills at the northern extremity of the basin. The topography of the basin is shown on 19 Geological Survey Maps (1970 Photorevised), compiled at a scale of 1:24,000 (see Plate B-3), with 10-foot contour intervals. Most of the basin is relatively flat with low rolling hills that are seldom higher than 200 feet. These hills are generally composed of unconsolidated glacial materials.

Stream valleys and drainage areas are poorly defined, resulting in extensive interior swamps and marshes. This is particularly true of the central portion of the basin.

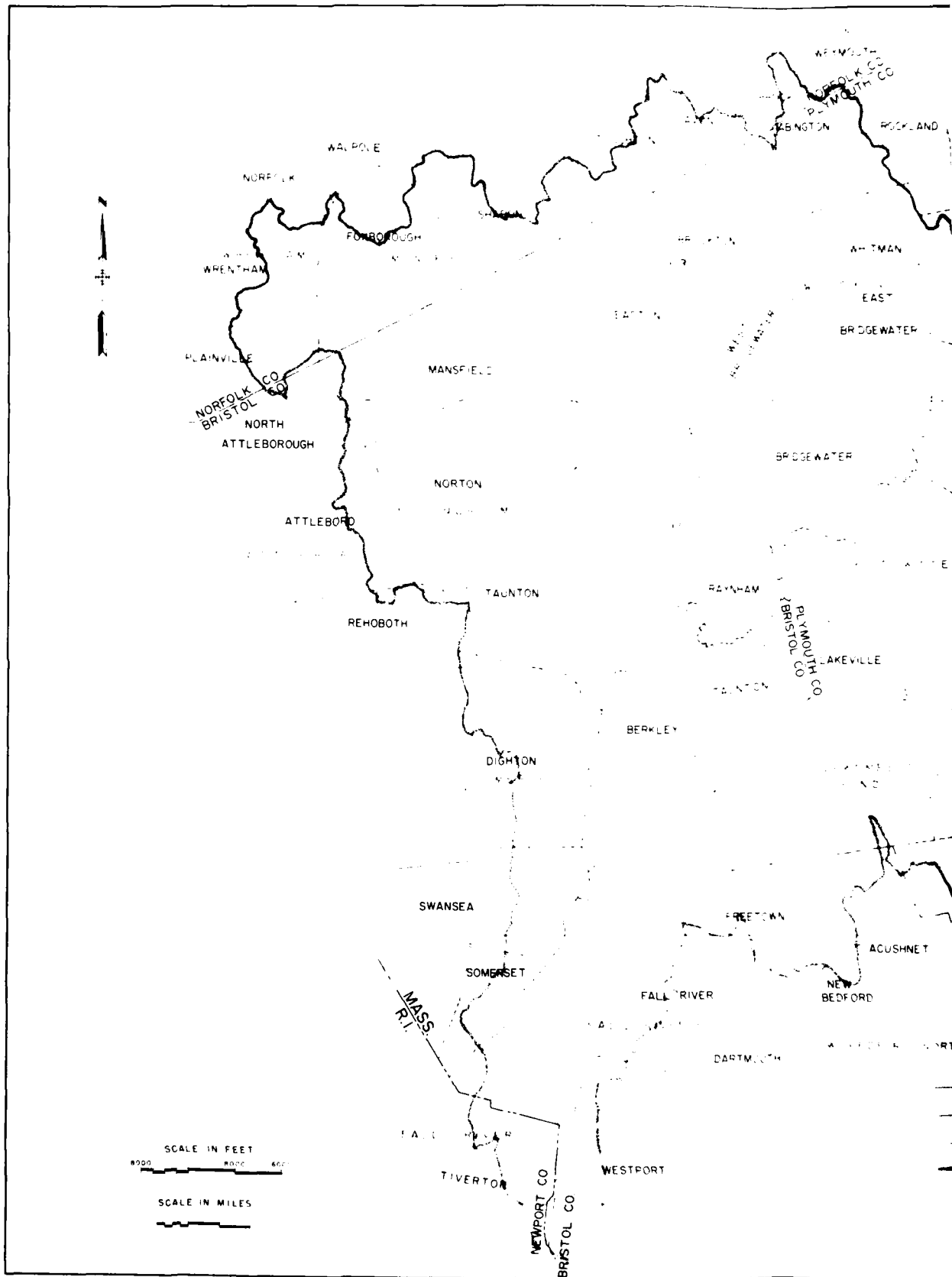
The lack of a ridge and valley type of topography has resulted in development of transportation corridors and communities that are more widely dispersed than in areas where developments closely follow river channels.

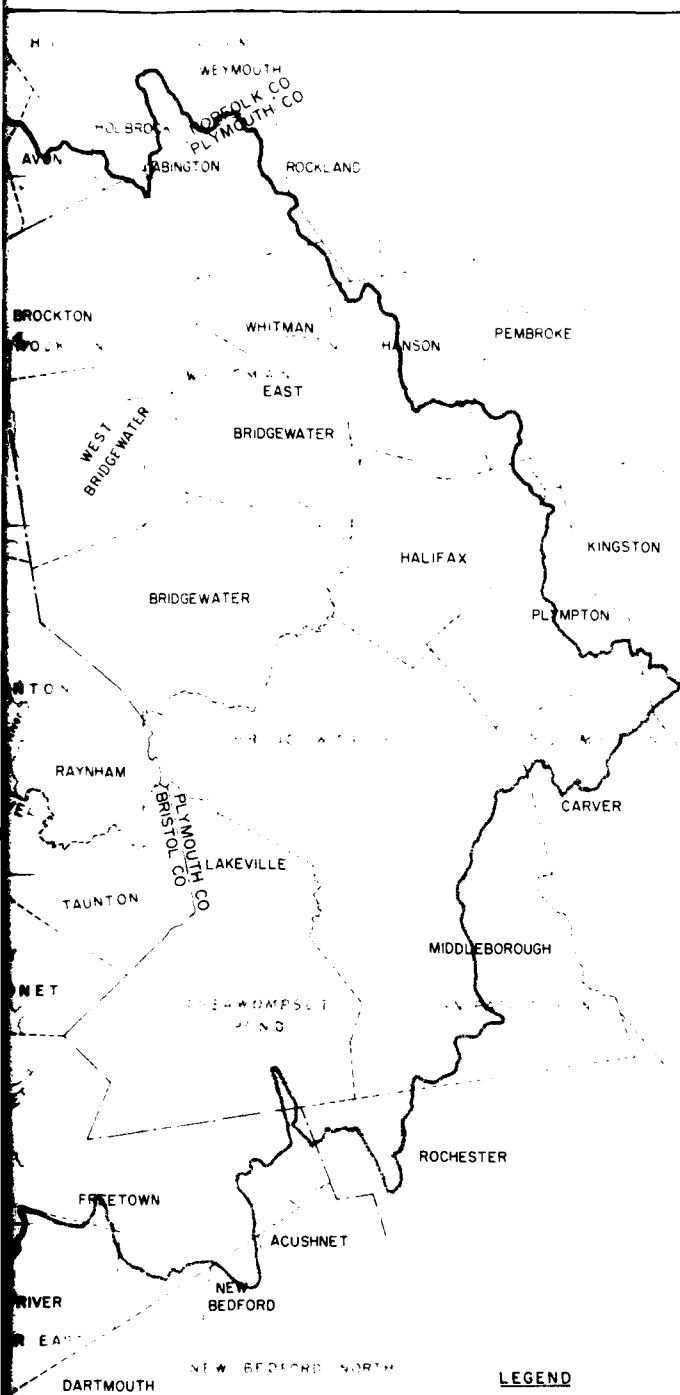
SURFICIAL GEOLOGY

Unconsolidated surficial deposits of glacial origin mantle the bed-rock surface to varying degrees throughout the basin. Postglacial deposition is confined to inland swamps, sand beaches and areas along rivers and streams. The distribution of surficial deposits within the Taunton watershed is shown on Plate B-4. Principal glacial deposits consist of, but are not limited to, the following:

(1) Glacial Till - An unsorted, nonstratified, compact, low permeability material underlies most of the other deposits and also forms the irregular hills of the basin. The particles range in size from clay to boulders. Thin deposits of till may occur as a veneer directly over the rock surface at the highest elevation.

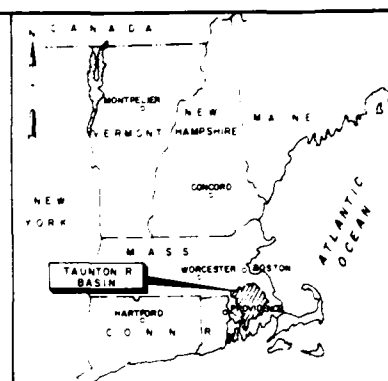
(2) Glaciofluvial Deposits - These stream-laid materials of glacial origin formed in a variety of depositional environments. They generally consist of stratified drift and outwash deposits of a permeable to semipermeable nature that are primarily made up of sand.





LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- WATERSHED LIMIT
- WATERWAY
- NAME OF WATERWAY
- U.S.G.S GAGING STATION

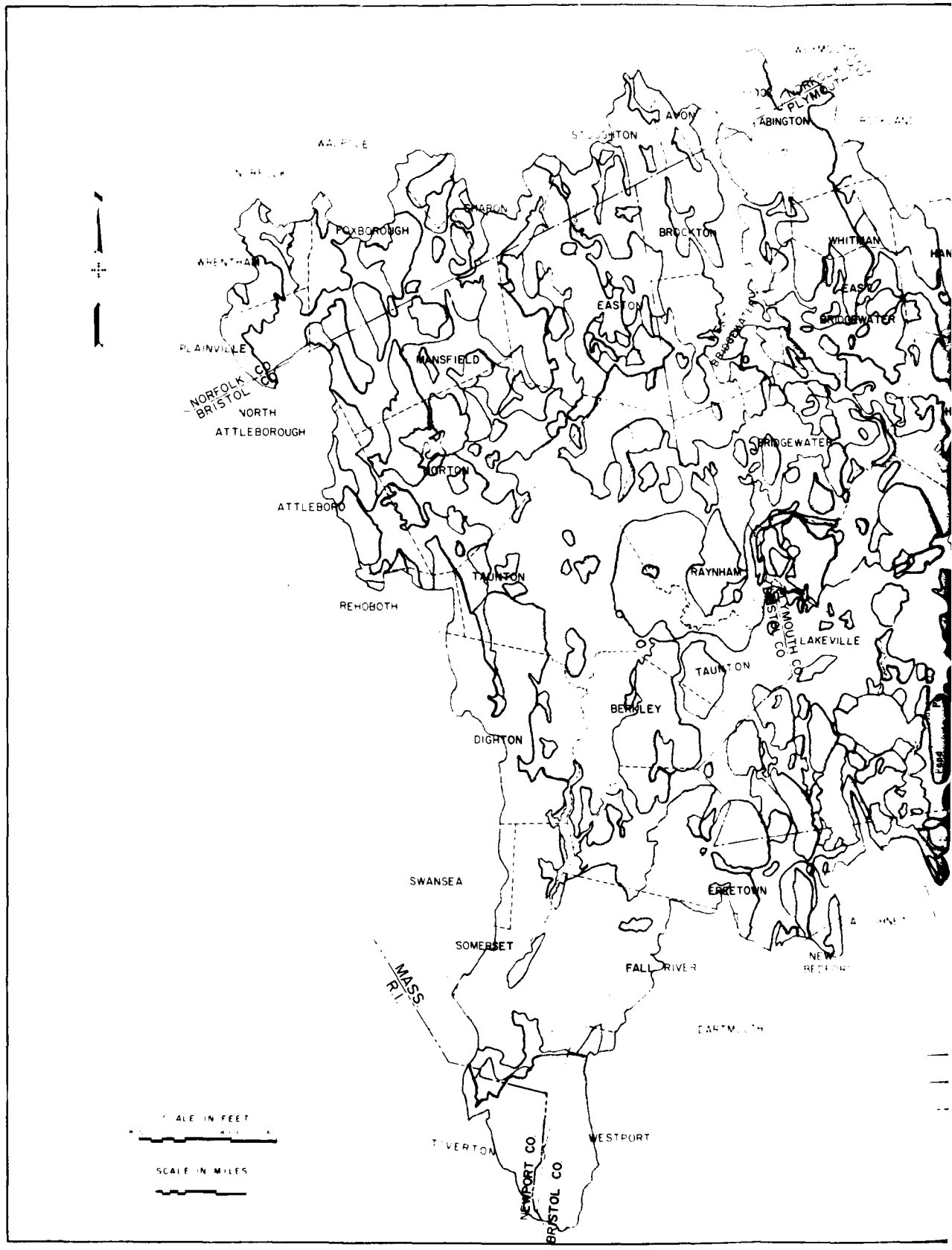


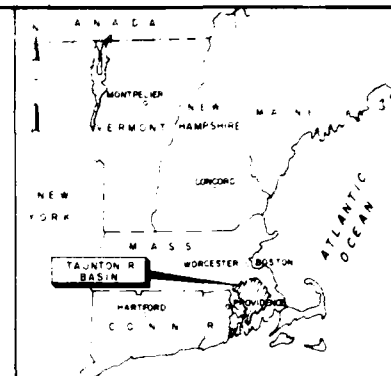
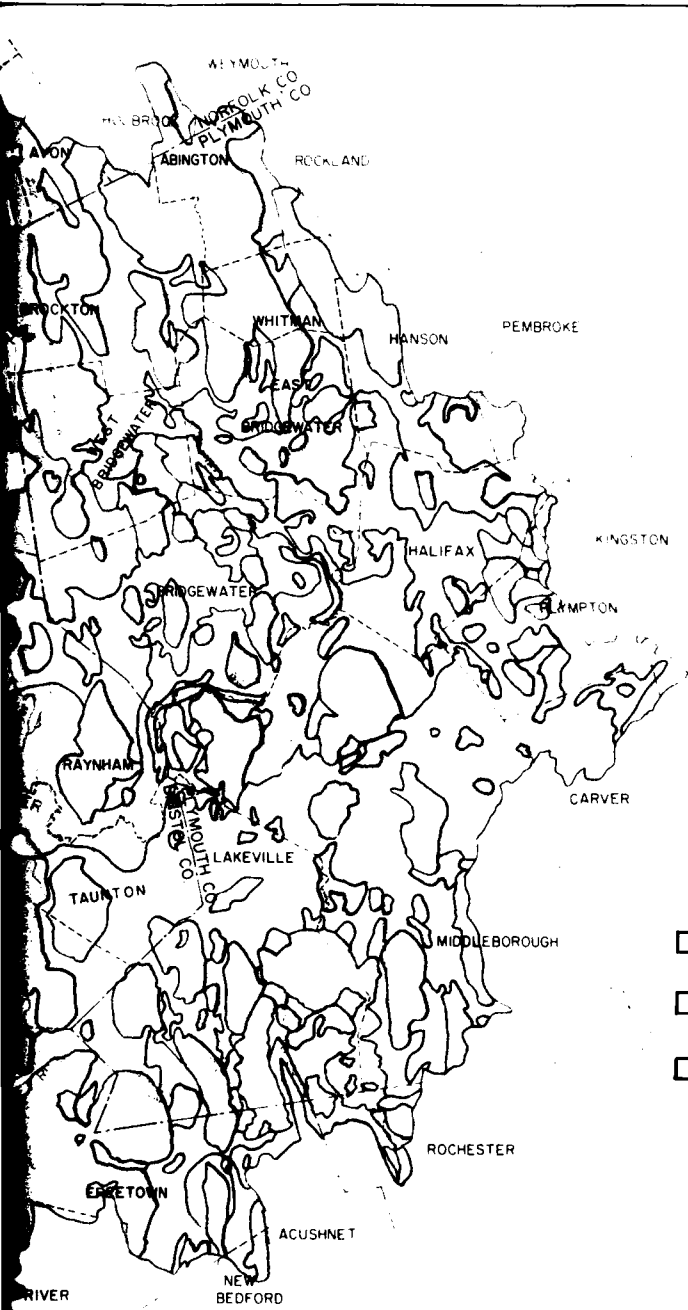
LOCATION MAP
SCALE IN MILES
0 25 50

WATER RESOURCES MANAGEMENT REF. #
TAUNTON RIVER BASIN
MASS - R 1

INDEX TO U.S.G.S
TOPOGRAPHIC MAPS

DEPARTMENT OF THE ARMY
U.S. GEOLOGICAL SURVEY
WASHINGTON, D.C.





LOCATION MAP

SCALE IN MILES
0 10 20 30

SURFICIAL LEGEND



UNSORTED MIXTURE OF CLAY, SILT, SAND, GRAVEL BOULDERS.
LOCALLY VARIABLE. BEDROCK MAY BE EXPOSED "TILL"



STRATIFIED SAND AND GRAVEL WITH SOME SILT AND/OR CLAY.
LOCALLY VARIABLE. LOCAL FLUVIAL DEPOSITS



SILT, SAND, CLAY AND ORGANIC MATERIAL
(GLACIAL CLAY WITH DEPOSITS)

LEGEND



STATE BOUNDARY



COUNTY BOUNDARY



MUNICIPAL BOUNDARY

WATERSHED LIMIT

WATERWAY

NAME OF WATERWAY

U.S.G.S. GAGING STATION

WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R I

SURFICIAL GEOLOGY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

and gravel-size particles. These deposits, which form irregular hills and poorly defined terraces, are the most prevalent materials found in the basin.

(3) Glaciolacustrine Deposits - These sands, silts, clays and varved clays formed as nearly continuous deposits beneath the glacial lakes and may occupy many of the topographic lows throughout the basin.

Planning Factors - The strongest geologic restraints placed on future planning and development of the basin are the subsurface materials. Land and subsurface material patterns dictate to a high degree the corridors available for transportation, utilities and future expansion of the existing communities. Poor subsurface drainage and the accompanying poor foundation bearing capacities are found extensively throughout the basin and restrict the types of development. Large areas of poor drainage and a generally high subsurface water level make careful planning of solid and liquid waste disposal a necessity. Those materials susceptible to landslides, where present in the basin, generally occupy areas with little relief and, therefore, are quite stable. Planning concepts should place strong emphasis on the highly variable topography and subsurface materials throughout the basin. For additional guidance in evaluating planning factors see Table B-7.

Engineering Factors - For effective designs, careful consideration must be given to the extensive areas with materials of low bearing capacity and high water table in the basin. Compressibility of the foundations may require higher than normal costs of construction and require design studies for fills or heavily loaded multistory structures. High costs of pumping may occur with deep excavations. Construction work in soft sediments requires adequate safety procedures, and consideration of frost susceptibility in highway and utility corridors is extremely important. These conditions make planning around the engineering properties of the soils a necessity. Further consideration of some engineering factors may be determined by comparison of Table B-8.

Construction Factors - Extensive, soft, poorly drained areas increase the costs of foundation preparation for transportation corridors and buildings, particularly in the central areas of the basin. Adequate fill is readily available in the form of pervious glacial deposits. The low relief dictates relatively low cuts with the high probability of balanced

TABLE B-
SURFICIAL GEO
PLANNING FAC

Type of Deposit	Topographic Utilization	Best Land Use	Surface Drainage	Permeability Rate	Surface Drainage
Glacial Till	Private Homes High Rise Hiking Trails	Suburban Recreation	Good	High	Poor
Glacio-fluvial	Highways Railroads Airports Home Construc- tion, Suburban Center, Industrial Dev., Farming	Urban Commercial Development Agriculture Recreation	Good to Limited	Medium to Low	Good
Glaciola- custrine	Flood Storage Conservation Limited Commercial Uses Utility Corridors	Conservation Specialized Commercial Uses	Poor	Low	Poor

TABLE B-7

SURFICIAL GEOLOGY
PLANNING FACTORS

	Subsurface Drainage	Waste Disposal		Landslide Susceptibility	Hazards	
		Solid	Liquid		Vibration Potential	Earthquake Effects
-off e h	Poor	Poor	Poor to Limited	None	Minimal	Slight
lium low	Good	Good to Limited by Drainage Pattern	Good to Limited by Water Table	Steep Terrace Scarps Slide Type Failures	Moderate to High	Slight to Moderate
y	Poor	Limited Depending on Drainage	Poor	High with Collapse Type Fail- ure Possible on Coastal Scarps	High	High

TABLE B-8

SURFICIAL GEOLOGY
ENGINEERING FACTORS

Type of Deposit	Material Description	Thickness of Deposit	Drainage Characteristics	Excavation Characteristics	Bearing Capacity	Frictional Stability
Glacial Till	Unsorted mixture of clay, silt, sand, gravel and boulders	Average to less than 25'. Thin to absent on tops of hills thickening to 50' on lower slopes. Streamlined hills maybe 150'± thick	Fair to Poor	Mod. hard to difficult	Good	High
Glacio-fluvial	Stratified sand and gravel with some silt	Generally less than 125'. In small valleys commonly less than 40'.	Good to Excellent	Little difficulty. In valleys of tidal rivers maybe excavated by dredge.	Fair to Good	No Settlement
Glaciolacustrine	Silt, sand clay and organic material	Generally shallow in inland areas 15'±, thickens on seaward margins to ± 40'	Poor	Easy	Poor	Medium to High

TABLE B-8

SURFICIAL GEOLOGY
ENGINEERING FACTORS

ation tters-	Bearing Capacity	Frost Suscepti- bility	Average Slope (Deg.) (Natural)	Cut Slopes Max. (Deg.)	Compres- sibility & Expansion	Unit Dry Weight PCF
hard icult	Good	High	25 ⁰	0-15'=90 ⁰ - 15-40'-28 ⁰ -2:1 +40'=by design	Very Slight	100-135
dif- . In s of ivers	Fair to good vibratory loading may cause settlement	None to Slight	5 ⁰	Cut slopes stable to angle of re- pose	None	115-145
ted dge.	Poor	Medium to High	0-2 ⁰	Poor. Un- stable. Flows read- ily into underwater excavation	Medium to High	90-130

cut and fill systems varying with the profile of the traverse selected. Other construction factors in relation to the geology of the basin are identified in Table B-9.

BEDROCK GEOLOGY

The Taunton River Basin is underlain by a broad synclinal structure with its axis trending northeast-southwest. The central portion of the syncline occupies the majority of the basin and is composed of sedimentary rock varieties such as sandstone, conglomerate, arkose and shale. Considerable deposits of meta-anthracite coal may be within these rocks. The northwestern and southeastern sections of the basin are underlain by igneous granites, diorites and gabbros which border the synclinorium. The igneous rocks are considerably stronger, denser and structurally less variable than sedimentary rocks. The distribution of rock types is shown on Plate B-5.

Planning Factors - The igneous rocks with their high strength factors are desirable to use as construction material but are hard to excavate. Difficulty in excavation also must be considered during the location of transportation corridors. The increasing demand for energy sources and the advances in technology have caused many previously uneconomical coal deposits to regain status as worthwhile ore loads. The large deposits of meta-anthracite coal in the Taunton River basin may prove to be a potential valuable resource to the region, contingent upon future detailed investigations. Other factors prevalent in the Taunton River basin may be evaluated by referring to Table B-10.

Engineering Factors - The dominant sedimentary rocks of the basin possess medium to high strength and durability characteristics coupled with poor to good slope stability. Designs involving the igneous rock should utilize their high strength, durability and slope stability. The probability of successful bedrock water wells is far greater in the sedimentary rocks than the igneous rocks. Further application of engineering factors may be evaluated by reference to Table B-11.

Construction Factors - The relative ease of excavation and varying slope stability of the sedimentary rocks contrast sharply with the difficult excavation characteristics and good to excellent slope stability for the igneous rock types. This sharp contrast points out the need for preliminary site investigations and planning. Further

TABLE E
SURFICIAL GL
CONSTRUCTION

Type of Deposit	Transportation		Corridors		Water Construction		H'g Ris
	Above Ground		Below Ground		Below Ground		
Glacial Till	Poor		Good		Diffi- cult with High Cost		Good Moderate
Glacio-fluvial	Good		Poor to Moder- ately good depending on water table		Good to Moder- ately difficult with least expense		Good Moderate
Glaciola-ustrine	Good limited by low bearing		Poor		Difficult with Mod- erate expense		Poor

TABLE B-9

SURFICIAL GEOLOGY
CONSTRUCTION FACTORS

Utility Construction		Building Construction			Source of Construction Materials
Above Ground	Below Ground	High Rise	Commercial Buildings	Private Homes	
Good	Difficult with High Cost	Good to Moderately good	Poor	Good	Moderately Favorable
Good to Moderately difficult	Easy to Moderately difficult with least expense	Good to Moderately difficult	Good	Good with limitations depending on water table	Highly Favorable
Poor to Moderately good depending	Difficult with Moderate expense	Poor to limited depending on design	Limited depending on design	Poor	Limited to specialized uses

TABLE B-10

BLUE-FOOT GEOLOGY
PLANNING FACTOR

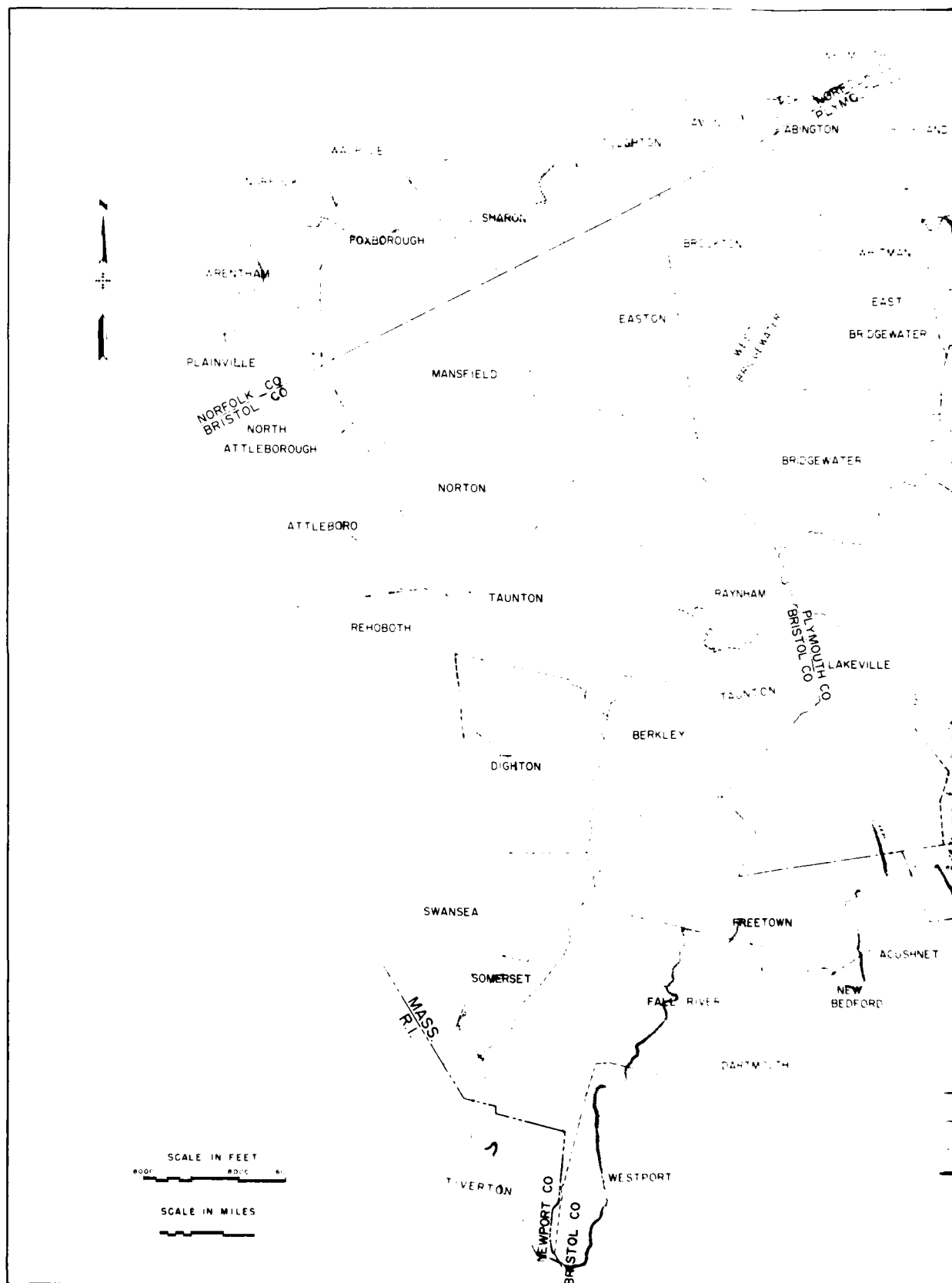
Tunnel Fe

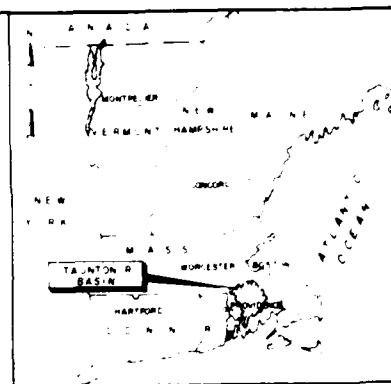
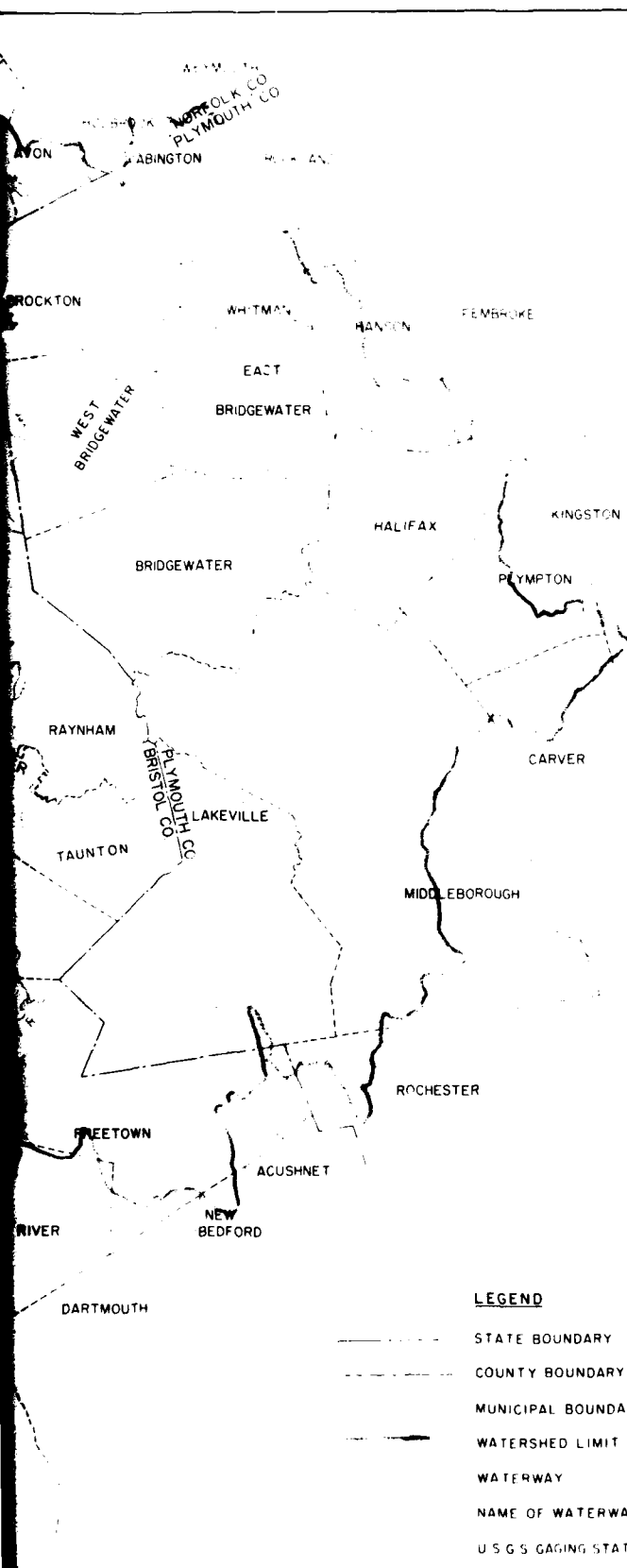
Type of Deposit	Topographic Representation	Surface Excavation Difficulty	Well Development Potential	Control of Cont. Slopes	Machine
Igneous	High Relief and Frequent Surface Exposure	High	Poor	Good	Poor to Good
Sedimentary	Low Relief with Infrequent Exposures	Low	Good	Good	Good to Excellent

TABLE B-10

BEDROCK GEOLOGY
PLANNING FACTORS

Control Cut Slopes	Tunnel Feasibility		Hazards		
	Machine	Conventional	Rock Slopes Stability	Quarries and Pits	Potential Quarry Operations
Good	Poor to Good	Good to Excellent	Good to Excellent	Large and Numerous	High
Good	Good to Excellent	Good	Poor to Good	Limited	Poor





LOCATION MAP
SCALE IN MILES
0 10 20 30

BEDROCK LEGEND

- LUNESSE, HARD TO VERY HARD MASSIVE LITHO TYPES INCLUDES SOME MASSIVE GRANITE VARIETIES
- SEDIMENTARY SOFT TO MODERATELY HARD VARIABLY INTERBEDDED VARIETIES

LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- WATERSHED LIMIT
- WATERWAY
- NAME OF WATERWAY
- U S G S GAGING STATION

WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R.I.
BEDROCK GEOLOGY

DEPARTMENT OF THE ARMY
WATERWAYS DIVISION, BRIDGE ENGINEERS
WASHINGTON

TABLE B-1

BEDROCK GEOLOGICAL
ENGINEERING FACTORS

Type of Deposit	Material Description	Excavation Characteristics	Compressive Strength P.S.I.	Dry Unit Weight L.B./C.F.	Durability
Igneous	Hard to very hard, massive, glassy to granular texture with interlocking grains	Uniform stability difficult excavation effective shaping	High to very high	162 to 173	Good to Excellent
Sedimentary	Soft to moderate hard stratified with fragmental texture of rounded to sorted grains	Directional stability Fast excavation Shoring highly Dependent on stratification	Very low to medium	155 to 170	Poor to Good

TABLE B-11

BEDROCK GEOLOGY
ENGINEERING FACTORS

Dry Unit Weight LB/c.f.	Durability	Depth of Weathering	Youngs Modulus of Elasticity	Slope Stability	Surface Bearing Capacity (Avg.) T.S.F.	Permeability Yield of Wells Median Range G.P.M.
162 to 173	Good to Excellent	Slight	Low to very high	Good to Excellent	100	6-12
155 to 170	Poor to Good	Slight except for deeply altered clay zones	Very low to high	Poor to Good	25	10-25

evaluation of the bedrock formations in relationship to their construction characteristics may be evaluated by reference to Table B-12.

MINERAL RESOURCES

Sand and gravel deposits are widespread in the basin and are commonly worked on a small scale for various local uses. Two principal producers are at Assonet and Wrentham.

Commercial production of stone is limited. Granite is quarried at Wrentham; basalt (and at one time granite and diorite) is quarried near Stoughton. Sandstone was quarried on a small scale at Assonet and Wrentham.

Coal was once mined on a small scale near Mansfield. It is also present at Wrentham, Foxboro, Raynham, Bridgewater, West Bridgewater and Middleboro. Substantial brick clay has been produced at Middleboro and Bridgewater.

SEISMIC ACTIVITY

The basin is located in Zone 2 of the Seismic Risk Map. This indicates possible earthquake intensities of VII on the Modified Mercalli Scale (moderate damage). Appropriate design factors should be applied.

WATER SUPPLY

Groundwater-The Taunton basin is underlain by sedimentary rocks which occupy the central portion, and igneous rocks which outcrop in the North and South. Groundwater is contained in and transmitted through fractures and other openings in the rock. Igneous rocks typically yield only small amounts of water. Sedimentary rocks are variable and can in some cases produce moderate supplies of water.

The bedrock is mantled discontinuously by unconsolidated glacial till and glaciofluvial deposits. The glaciofluvial sands and gravels, which are capable of supplying substantial groundwater yields, are found primarily in the lower elevations of the basin. Till has low permeability and usually yields amounts suitable only for domestic needs. Glaciolacustrine deposits are often clayey and generally are not regarded as good sources of groundwater.

BE
CONS

Type of Deposit	Underground Excavation Methods		Surface Excavation	Drill Blast
	Machine Excavation	Conventional Excavation	Utility Locations	
Igneous	Poor to Good	Good	Poor, rock is generally shallow and most difficult to excavate	Most least expensive
Sedimentary	Good to Excellent	Poor to Good	Good to Excellent. Rock is deeply buried and least difficult to excavate	Cost depends on size and shape of excavation

TABLE B-12

BEDROCK GEOLOGY
CONSTRUCTION FACTORS

Surficial Excavations

Utility Locations	Drill and Blast Methods	Mechanical Methods	Excavation Difficulty	Source of Construction Material
Poor, rock is generally shallow and most diffi- cult to excavate	Most rapid least expensive	Slow Highly Expensive	High	Good to Excellent
Good to Excel- lent. Rock is deeply buried and least diffi- cult to excavate	Cost de- pendent on size and shape of excavation	Least ex- pensive for large shallow excavation	Low	Poor

The yield of wells in the stratified drift has been estimated in different ways. The extent and lithology of the stratified drift deposits have been mapped extensively, and much information regarding permeability, transmissivity and water yield capability has been compiled and analyzed. Extensive information regarding surface hydrology in the area is also available. This information, when analyzed and examined in different ways, leads to different estimates for the groundwater potential of the basin. The extremely large size of the basin, however, precluded much specific data for local areas. The available data and information, while reliable, must be viewed on a more generalized, big picture basis rather than being specific and/or exact for a given local area. Groundwater yield estimates derived from this information must be viewed in the same way, i.e., reliable but generalized. A conservative estimate is found in a USGS open file report (Frimpter, 1973 Taunton River Basin) which gives estimated minimum groundwater discharges, as based upon streamflow measurements, for each of the communities in the basin. The sum of these minimum groundwater discharge estimates is 78 mgd. Information supplied by the U.S. Geological Survey indicates that 78 mgd is approximately equal to the 97 percent flow duration of the streams draining the basin. This means that if 78 mgd were withdrawn and continually exported from the basin, and if there was a long period of no recharge, it is likely that portions of the streams in the area would tend to dry up the remaining 3 percent of the time.

Of the 23 towns and cities entirely in the Taunton River watershed area, a survey has identified municipalities that cannot meet estimated 1995 water demands with groundwater. These communities are Avon, Brockton, Fall River, Foxborough, Taunton and Whitman. Of those municipalities that can meet estimated 1995 demands with groundwater, East Bridgewater, West Bridgewater, Easton, Halifax, Lakeville, and Bridgewater will be considered. Freetown will be discussed under the Taunton Water Department section.

East Bridgewater used an average of 0.72 mgd from three gravel-packed wells with a capacity of 2.30 mgd. The municipality has plans to develop an additional well with a yield of 0.5 mgd.

Together these sources should be sufficient to meet a 1995 maximum day demand of 2.70 mgd.

West Bridgewater used an average of 0.58 mgd in 1975 from two gravel-packed wells and a well field with a combined yield of 1.9 mgd. Since the projected maximum day demand for 1995 is expected to be 2.43 mgd, West Bridgewater may need to develop additional sources.

The Easton Water Department supplied Easton with 100 percent of the town's 1975 average day water requirement of 1.38 mgd. This amount is less than a third of the system's pumping capacity of 3.20 mgd, all of which is obtained from groundwater sources (4 wells). Projections for 1995 indicate that Easton's maximum day demand will amount to about 4.06 mgd, so the town will have to find .9 mgd from new groundwater sources.

The total population of Halifax is served by the Halifax Water Department. Its average day 1975 demand of 0.30 mgd was met adequately by the water department's well (pumping capacity of 0.86). However, by 1995 the municipality's maximum day demand is expected to reach 1.56 mgd, so an additional 0.7 mgd of groundwater must be developed.

About 76 percent of Lakeville's population use individual private wells for water supply. The remaining 24 percent are served by a private supplier, Lakeville Hospital. The maximum day demand in 1995 is expected to be about 0.7 mgd. Lakeville's groundwater will continue to meet this requirement.

Bridgewater may be able to meet its estimated 1995 water demands with groundwater, but it will require low yield wells (200 gallons per minute or less) to tap thin, extensive aquifers or poorly conductive, fine-grained aquifers. Bridgewater's 1975 average day demand of 1.13 mgd was supplied by groundwater from three gravel-packed wells operated by the Bridgewater Water and Sewer Department. The pumping capacity of these three wells is 1.70 mgd. Another gravel-packed well, reserved for emergencies, has a yield of 0.40 mgd for a total capacity of 2.10 mgd. Bridgewater is also the site of the Massachusetts Correctional Institution, which operates its own water system. Bridgewater plans to develop an 8-inch well with a pumping capacity of 0.45 mgd, and the Correctional Institute is also conducting a study of an additional well site. As of 1995, Bridgewater's maximum day demand should be approximately 4.10 mgd, and 1.55 mgd would have to be developed for the municipality's future needs.

In order to maximize the potential for groundwater resources, it will be necessary for municipalities to maintain groundwater recharge and to prevent contamination from natural and man-made sources. Maintenance of sanitary landfills, storage and use of highway deicing salts and industrial waste disposal are a few of the activities that endanger groundwater quality. They should be restricted from recharge areas of both existing and potential municipal supply wells.

Surface Water - The Fall River system obtains its water from surface supplies with a safe yield of 16.5 mgd. The Fall River Water Department provides supplies to the city of Fall River (13.6 mgd or 100 percent of its supply), the Thomson chemical plant in Freetown (0.34 mgd), and the northern part of Tiverton, Rhode Island (0.32 mgd). The maximum day demand for the Fall River Water Department in 1975 was 18.9 mgd.

Fall River's original water supply, North Watuppa Pond, has a safe yield of 7.0 mgd. It is currently supplemented with water from two sources. Lake Noquochoke, an out-of-basin source located in Dartmouth, has an available safe yield of 3.0 mgd which can be pumped directly to North Watuppa Pond. However, this lake is used only in emergencies because of problems with its quality. Another surface source, the Copicut Reservoir, is located in Fall River and has a safe yield of 6.5 mgd. Supplies are pumped to North Watuppa Pond for treatment before distribution. Fall River also has rights to 11.5 mgd from Long Pond in the Lakeville Pond complex. Fall River has not exercised this right, and it has been proposed that Taunton and New Bedford, the other two parties in the agreement, acquire those rights. Fall River's currently developed supplies, not including the Lakeville Ponds source, are expected to be adequate through 1995. In addition to the Lakeville Ponds, Fall River also has three other potential sources: expansion of the Copicut Reservoir, further development and treatment of water from Noquochoke Lake and exercise of its unused stream rights of up to 6 mgd.

The Somerset Water Department supplies 100 percent of that municipality's maximum day demand, which in 1975 was 3.04 mgd.

The system obtains its water supply from a reservoir built recently on the Segregansett River in Dighton and a gravel-packed well in Somerset. The reservoir has a safe yield of 5.0 mgd, while the well has a

capacity of 0.27 mgd. These give the system a total existing yield of 5.27 mgd, which appears to be adequate to meet future increases in water demand through 1995.

Ninety-eight percent of the city of Taunton's population receive water from the city's water department. The remaining 2 percent still use individual private wells. In 1975, the demand on the Taunton Water Department amounted to 5.78 mgd. An additional 0.39 mgd was supplied to the town of Dighton by the Taunton system.

The Taunton system uses surface water taken from Assawompset, Pocksha and Long Ponds of the Lakeville Ponds complex for its source of supply. Under the terms of the 1924 Tri-City Agreement (with Fall River and New Bedford), Taunton's share of the Lakeville Ponds complex is an average of 8.0 mgd (depending on the water level). An additional 1.5 mgd can be taken as an emergency supply from the Taunton River, raising the safe yield of the system to 9.5 mgd. The existing supply of the Taunton system should be able to meet expected demand of the present service area through 1995.

Freetown - The Lakeville Ponds also provide a source of municipal supply to Freetown through the New Bedford Water Department. Some 0.03 mgd are supplied to a small service area of 150 people, about one-third of the 10 percent of Freetown's population supplied by a municipal system. The other two-thirds are served by a local ground-water system, while the remaining 90 percent of the residents are served by individual private wells.

Ninety-eight percent of the town of Dighton's population gets its water from either the Dighton Water district or the North Dighton Fire District. The remaining 2 percent own individual private wells. The Dighton Water District supplied 0.36 mgd of Dighton's 0.56 mgd demand, while the North Dighton Fire District supplied the remaining 0.39 mgd in 1975.

The Dighton Water District uses two wells which have a combined pumping capacity of 0.66 mgd. A supplement of one million gallons per month is purchased from the Taunton Water Department. The North Dighton Fire District purchases its entire 0.39 mgd supply from the Taunton Water Department. Dighton's 1995 demand is projected to be 0.98 mgd. Existing supplies should be sufficient to meet this need.

The Raynham Center Water District and the North Raynham Water District served 76 percent of Raynham's population at an average rate of 0.6 mgd from groundwater sources in 1975. The remaining 24 percent use individual private wells for their supplies. The existing supplies of both water districts are expected to be inadequate to meet the town's 1995 projected average day demands of 1.61 mgd. North Raynham has held meetings with the water systems serving Bridgewater and West Bridgewater to discuss opportunities for regional water supply management.

The town of Foxborough faces the problem of low yield aquifers. Large increases in demand may result in inadequate supplies for the town's future demands. Currently, 100 percent of Foxborough's water need is met by the Foxborough Water Department. In 1975, this amount averaged 1.72 mgd. The system furnishes an additional .006 mgd to Sharon. For its source of supply, the Foxborough Water Department uses ten gravel-packed wells with a pumping capacity of 4.70 mgd. The projection for Foxborough's 1995 maximum day demand is 4.20 mgd so the town will not have to develop additional groundwater sources.

The total population of Mansfield was served through the town water department at an average rate of 1.72 mgd in 1975. Existing pumping capacity from its municipal groundwater sources is 2.6 mgd plus a reserve supply with a yield of .58 mgd. The town is planning to purchase land for additional groundwater supplies. However, Mansfield will have to look outside its borders to supply its peak needs as its local groundwater supplies will be insufficient to meet the projected 1995 maximum demand of 4.33 mgd.

Middleborough - The Middleborough Water and Sewer Department served 100 percent of the town at an average rate of 0.88 mgd in 1975. The system's 1.8 mgd capacity from groundwater sources is considered insufficient to meet expected future average demands of 1.53 mgd.

Norton - The town water supply system served all of Norton's water requirements at an average rate of 0.87 mgd in 1975. The system has a 2.0 mgd pumping capacity from its groundwater sources, some of which must be treated for manganese. Steps should be taken to protect these sources from highway construction and deicing salt contamination, if or when an extension of Route I-495 is constructed in the area.

WATER QUALITY

Existing water quality in the Taunton River Basin ranges from Class A to Class C. Those ponds in the Class A category, which is designated for use as a source of public water supply in accordance with the provisions of Chapter III of the General laws, are North Watuppa Pond, Assawompset Pond, Focksha Pond and Great and Little Quittacas Ponds. Class B water, which is suitable for recreational purposes and public water supply with treatment, is found throughout the majority of the basin. Class C which is suitable for Fish and Wildlife Habitat and Boating is present at parts of the Quequechan River, the Matfield River, the Nemasket River and at lower reaches of the Taunton River. A map showing these water quality classifications, as established by the Commonwealth of Massachusetts Division of Water Pollution Control, Water Resources Commission in 1975, is presented in Plate B-6.

As specified by Public Law 92-500, by 1983 all public water shall have attained Classification B. If, by that time, a given body of water has not met the standard, it must be proven that adverse social or economic circumstances exist resulting in irreversible man-made conditions. These goals should be accomplished in most, but not all, areas of Taunton.

Water quality degradation can be attributed to both rural and urban problems. The rural problems along the Winnetuxet River can be attributed to the agricultural practices in the area. Urban problems along the mainstem and the Salisbury Plain and Matfield rivers are caused by the apparent deficiencies of the Brockton Wastewater Treatment Facility. The lower segment of the Taunton River is not meeting present classification SC (Class C, tidal) standards due to urban runoff and contributing pollution from upstream source. This situation should improve, however, as the enlarged Taunton Wastewater Treatment Plant begins operation. At that time the quality will be upgraded to Classification SB (Class B, tidal).

VEGETATION

The study area is a portion of the eastern deciduous forest biota. Its primary wildlife is associated with forests and their successional stages. Three basic types of terrestrial habitats are found in the area: upland and lowland forests, land cleared by man and open wetlands. Common

tree species of upland deciduous forests include black, red, white and scarlet oaks. Red maple, swamp white oak, elm and red ash trees are found in the wetter lowland areas. Cleared lands are used for crops, fallow fields and pastures. The open wetlands in the study area include both fresh marshes and shrub swamps. Vegetative cover in fresh marshes is composed of plants such as cattails, bull-rushes and spike rushes. The shrub swamps, which are in advanced plant succession, are trending toward wooded swamps.

SOILS

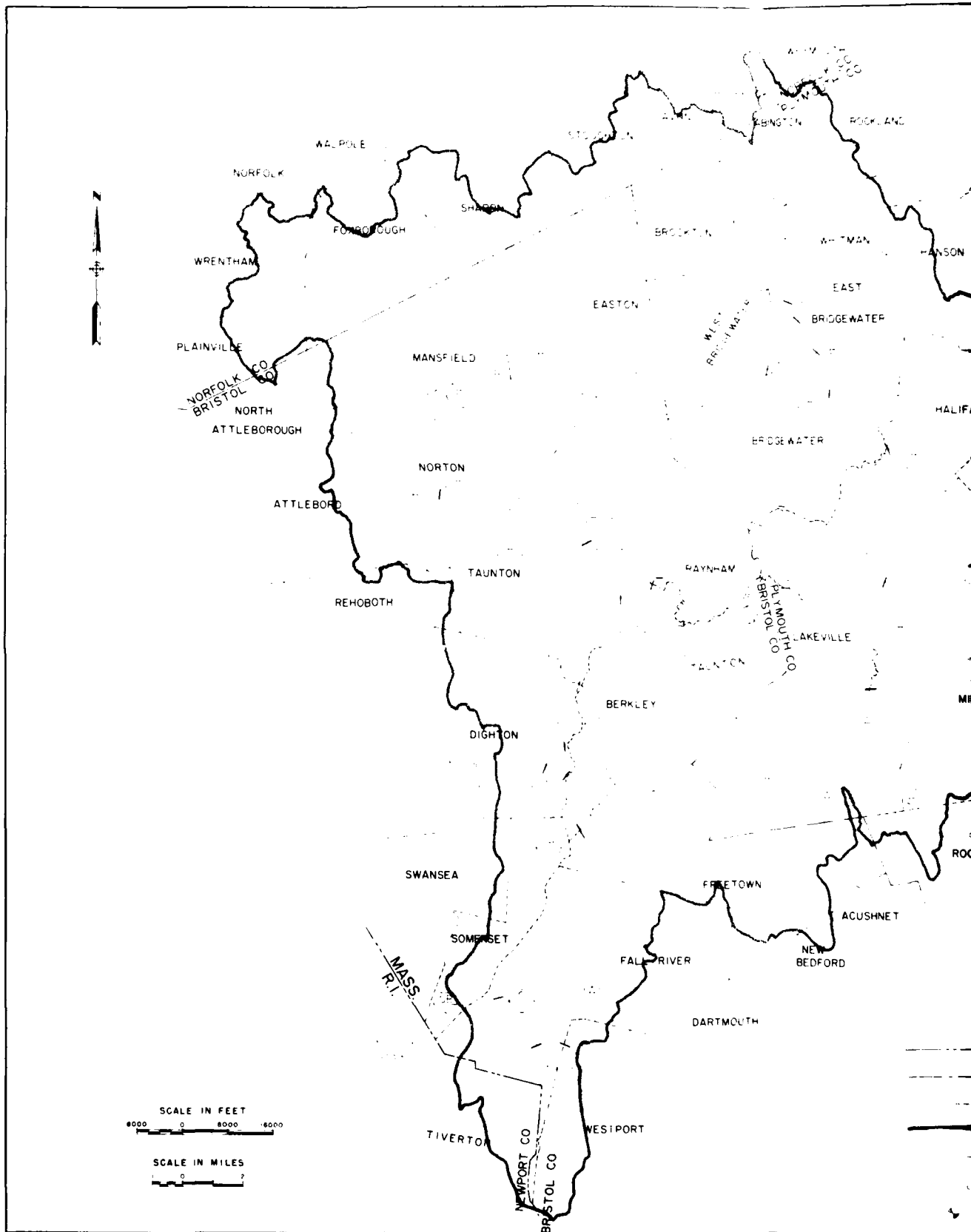
The general soils map for the Taunton Basin is shown on Plate B-7. This map presents the general soils association, and it may be useful to any of the public who want a general idea of which soils are present in the study area. It is not suitable for planning the management of a farm or field because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage and other characteristics that may affect proper management.

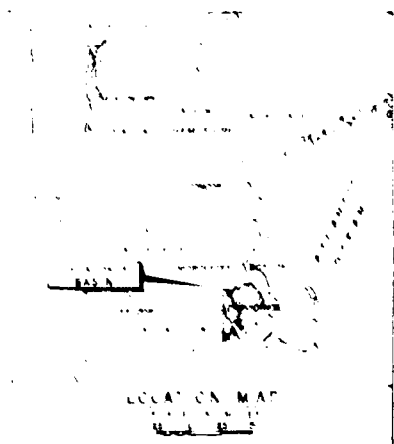
FISH AND WILDLIFE

Wildlife species which support the bulk of the hunting demands within the basin include the white-tail deer, snowshoe hare, cottontail rabbit, gray squirrel, opossum, racoon, pheasant, quail, ruffed grouse, woodcock and waterfowl. In addition, house sparrow, starling, red and gray fox, woodchuck, chipmunk, flying squirrel, red squirrel, weasel, porcupine, skunk and bobcat are not protected under existing laws and may be hunted. Mink, muskrat, weasel, skunk, fox, racoon, beaver, otter, bobcat and opossum may be trapped.

Harvestable fish species considered as "cold water" include the brook, brown, and rainbow trout. Principal "warm water" species include largemouth bass, smallmouth bass, chain pickerel, yellow perch, white perch, brown bullhead and various sunfish.

Land use is an extremely valuable indicator of current fish and wildlife populations. The current land use for all communities having 25 percent or more of its land area within the basin is shown in Table B-17. Dry forest land, forested wetlands, open wetlands and agricultural and open lands are considered to be the major habitat base for wildlife and constitute about 75 percent (275,000 acres) of the basin's total area. Open water, constituting about 5 percent of the





LEGEND

- STATE BOUNDARIES
- COUNTY BOUNDARIES
- MUNICIPAL BOUNDARIES
- WATERGATE DRAIN
- WATERWAY
- NAME OF WATERWAY
- WATERWAY NUMBER

NOTES

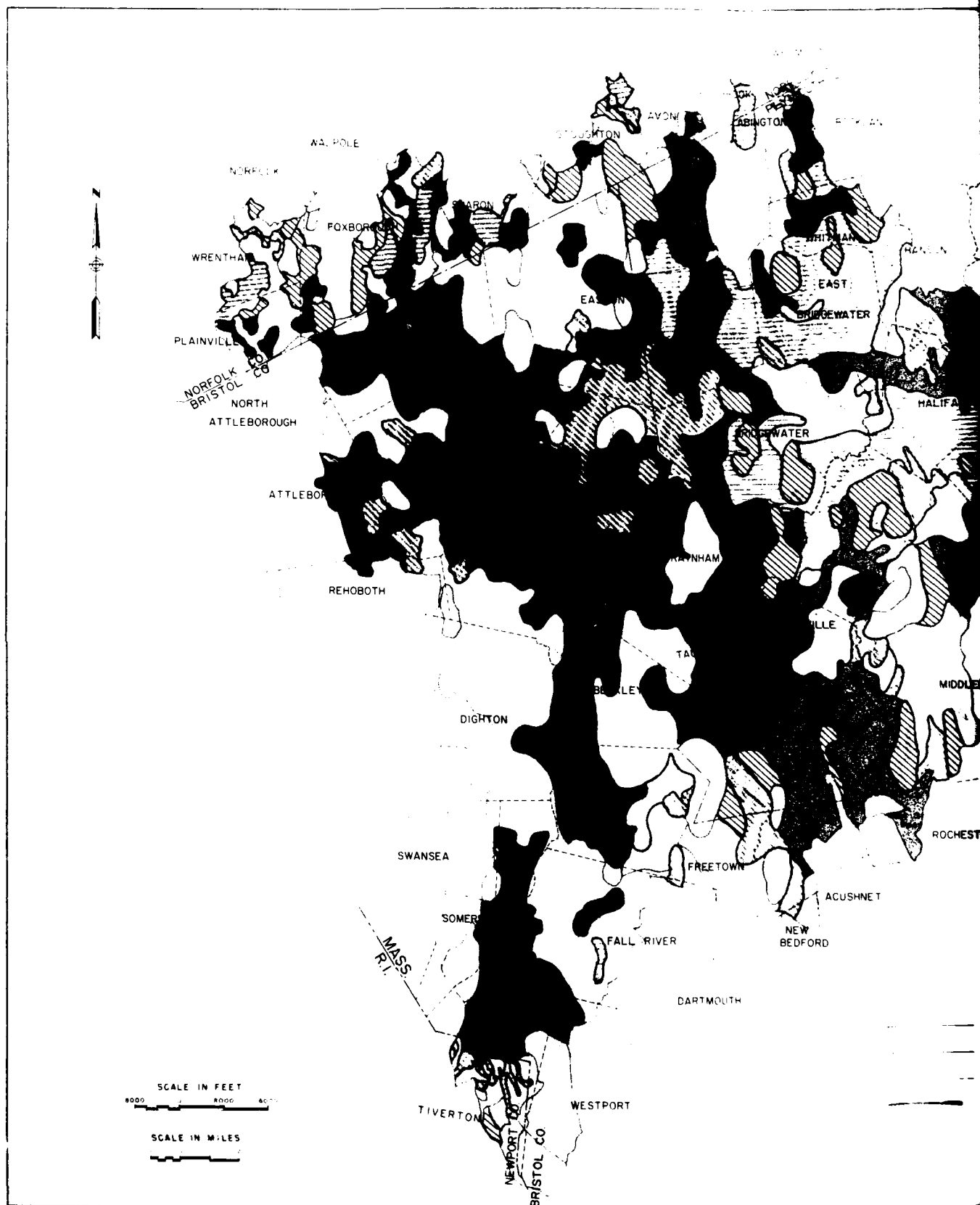
- 1. EXISTING WATERWAYS ARE SHOWN BY SOLID LINES.
- 2. PROPOSED WATERWAYS ARE SHOWN BY DASHED LINES.
- 3. WATERWAY NUMBER IS SHOWN IN PARENTHESES.
- 4. NAME OF WATERWAY IS SHOWN IN CAPITAL LETTERS.

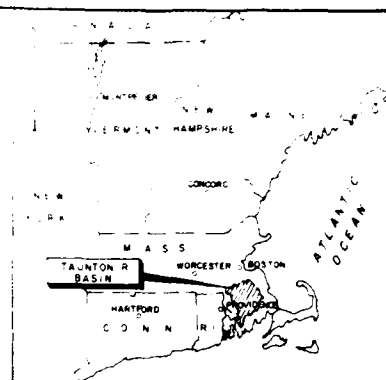
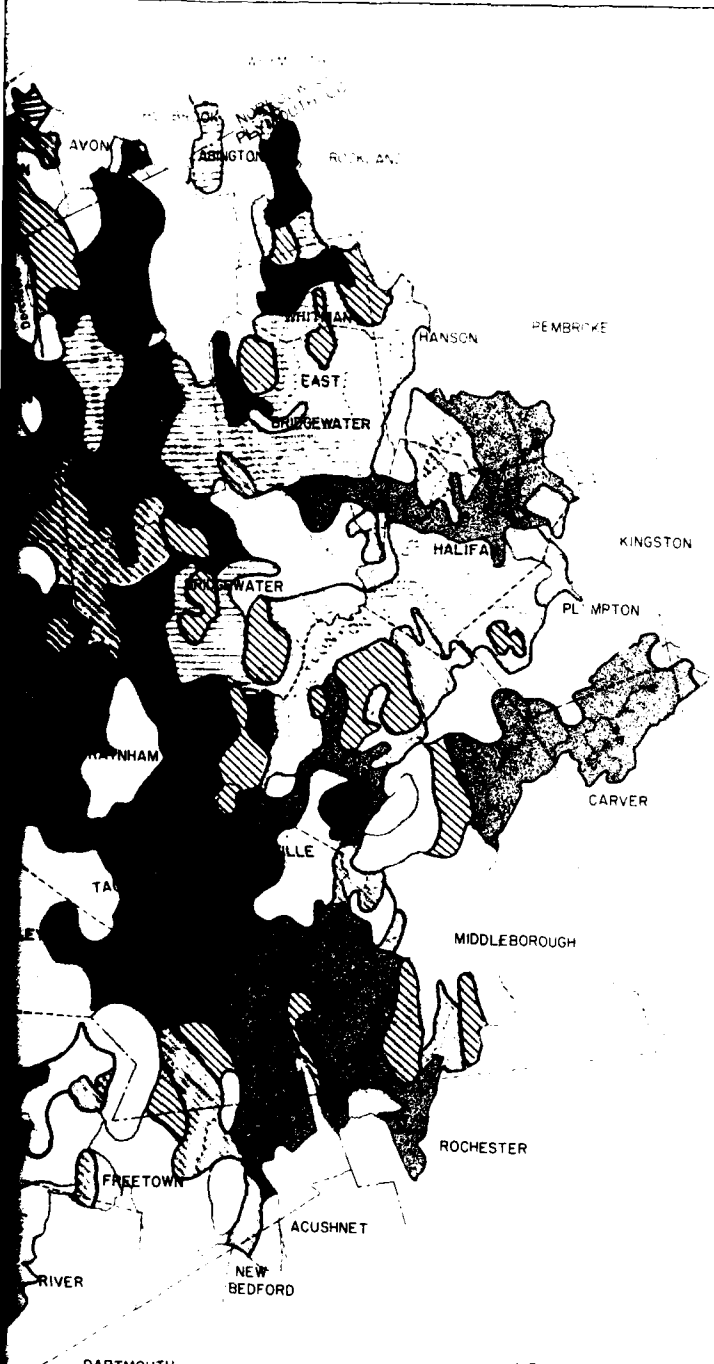
WATERWAY NUMBER MASSACHUSETTS
SALTON RIVER BASIN
MASSACHUSETTS

WATERWAY NUMBER
SALTON RIVER BASIN

WATERWAY NUMBER
SALTON RIVER BASIN

MASSACHUSETTS





LEGEND

- Droughty to well drained sandy, gravelly, on terraces on slopes < 15 %
- Droughty to well drained sandy, gravelly, on terraces on slopes > 15 %
- Well, moderately well drained, stony w/hardpans on upland slopes < 15 %
- Well, moderately well drained, stony w/hardpans on upland slopes > 15 %
- Poorly, very poorly drained mineral on level, nearly level slopes
- Very poorly drained organic
- Well, moderately well drained, stony w/hardpans, shallow to bedrock on upland slopes < 15 %
- Well, moderately well drained, stony w/hardpans, shallow to bedrock on upland slopes > 15 %
- Urban land
- Shallow to bedrock, very poorly drained, organic
- Well, moderately well drained stony w/hardpans, poorly, very poorly drained
- Droughty to moderately well drained sandy and gravelly, poorly, very poorly drained
- Shallow to bedrock, poorly, very poorly drained mineral
- Well, moderately well drained stony w/hardpans, poorly, very poorly drained

LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- WATERSHED LIMIT
- WATERWAY
- NAME OF WATERWAY
- U.S.G.S GAGING STATION

WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R 1

SOILS MAP

DEPARTMENT OF THE ARMY
ENGINEERING DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

total area, is obviously essential for fish and provides a habitat for numerous varieties of aquatic oriented wildlife species. Of the combined forested wetland and open forest land use categories, about 50 percent is rated as fair wildlife habitat. However, lands officially open to public hunting are limited and constitute less than 3 percent of the basin. Considerable use is made of private land for hunting but the usage has been decreasing in past years, a trend that will continue into the future.

Most of the open water in the basin is primarily suited for warm water species of fish. Only one pond surveyed by the SENE Study, Elders Pond, appears to have any cold water fishery potential. It is, however, currently a water supply reservoir closed to public fishing. Similarly, very few of the streams in the basin are capable of sustaining a cold water fishery, and these are a "put and take" endeavor.

The basin does not currently support any anadromous fishery due to river and stream pollution from upstream sources.

ARCHAEOLOGY

The State's Archaeological Site Files show a basinwide distribution of sites that are especially dense within the inter-tidal zones and at the heads of estuaries. At this level of study, it is possible to present an overview of the kinds of cultural resources likely to be encountered.

Evidence for human occupation in New England dates back approximately 10,000 years. During this time, upland areas were still glaciated while small bands of hunters followed a nomadic way of life, traveling up and down the river valleys in pursuit of the large game. Recognized by the appearance of a distinctive fluted projectile point, there is scant but confirming evidence for Paleo-Indian occupation in New England.

Sometime around 7,000 B. C. as the glaciers melted and the big game disappeared, climatic conditions changed from a tundralike environment to one of mixed pine and hardwood forest. The Paleo-Indian hunters were replaced by small groups of hunters who were pursuing small game and beginning to utilize a larger amount of vegetation. These early archaic people are recognized by an appearance of bifurcate base projectile points in their tool assemblage. Evidence of these people in New England is more available than for the Paleo-Indian, although it is still scant. Many of the bifurcate type points have been found in the Taunton River Basin and the Narragansett Basin in general.

The climatic warming trend continued into the middle and late Archaic Periods until the landscape was pretty much as it is today. There was a gradual tendency toward exploitation of larger areas of the environment and toward riverine and estuarine adaptation. By the end of the Archaic Period, a complete transition from a nomadic hunting culture to a more complex foraging pattern had taken place. Population grew and there was an increase both in the number and the types of sites, which at this time ranged from small campsites to semisedentary villages used on a seasonal basis.

During the Woodland Periods there was a significant shift toward intensive exploitation of coastal habitats and shellfish subsistence. Shell middens are a common indicator of Woodland sites as is the appearance of pottery.

At the time of European colonization, the Taunton River Basin was inhabited by the Wampanoags, one of the Algonquin-speaking tribes who inhabited most of the Northeast. The Wampanoags were wiped out by the plague of 1617.

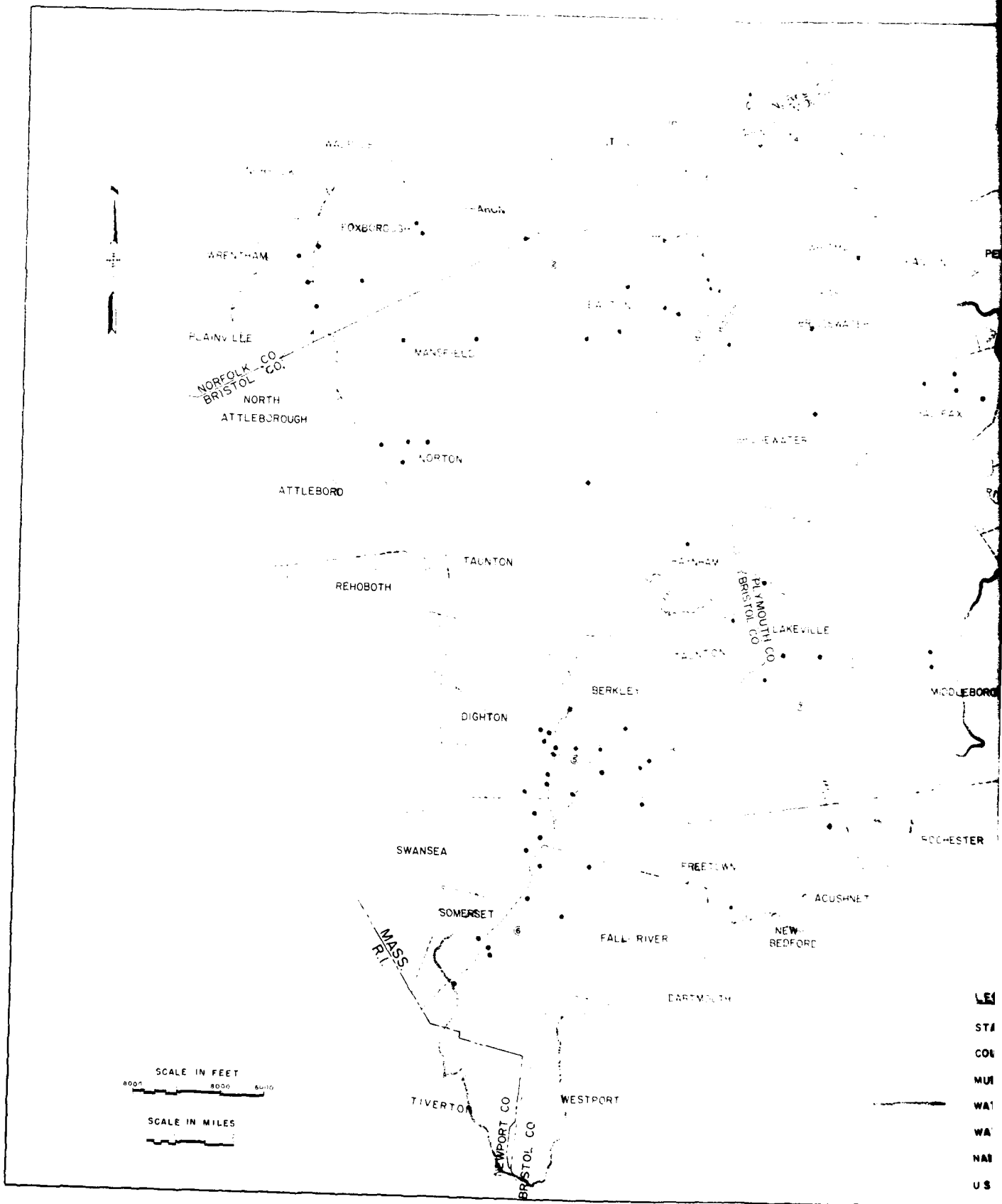
This area has been witness to a long history of settlement and industrial development. Along with the neighboring Blackstone River Basin, it played an important role in the early textile industry of southern New England. A wealth of historic properties and districts are listed in the National Register of Historic Places; and, owing to the relatively early development of this area, the possibility of finding many more is quite high.

OUTDOOR RECREATION

Recreational activities offered by the Taunton Basin are shown on Plate B-8 and are primarily of the warmer weather seasons, although ski touring is offered at three State Parks at Abington, Assonet and Easton.

Vast water resources are available with a multitude of fresh water ponds for boating, fishing and swimming. Most of the State and privately owned camping areas provide swimming facilities.

There are 15 State Parks in the Taunton Basin. The major ones are the Ames Nowell in Abington, West Meadows in Bridgewater, F. Gilbert Hills in Foxborough and Wrentham, Wrentham State Park in Wrentham and Plainville, Massasoit in Lakeville and Taunton, Freetown State Park in Freetown and the Freetown-Fall River State Park in Fall River. Scattered throughout the basin are 23 privately owned camp sites that offer additional recreational facilities.



Historic landmarks that are open to the public include the North Easton Historical District and the Railroad Station in North Easton, Bay Road in Easton, Brockton City Hall in Brockton, the North Abington Depot in North Abington, Dighton Rock in Berkley, the Academy Building in Fall River and the Wampanoag Royal Cemetery in Lakeville.

Twenty-one golf courses have been built in the basin area. The Bristol County section has 9, the Plymouth County section has 11 and Norfolk County has one.

In 1968 Congress enacted the National Trails System Act which designated the Warner Trail as part of the system. This trail passes through parts of Plainville, Sharon, and Foxborough that are within the Taunton Basin. More trails have been planned for Assonet, Dighton, Freetown and Raynham.

The majority of boating activity occurs on the lower segment of the Taunton River and near the mouths of the Segreganset and Assonet Rivers. The towns of Somerset and Dighton provide municipal boat ramps in addition to privately owned ramps in Fall River and Taunton. At Fall River, near the mouth of the Taunton River, there are two marinas and two boat clubs, in Somerset there are two marinas, in Dighton there are two yacht clubs and a marina and in Berkley there is a marina. On the Taunton River in Taunton there is a launching ramp, boatyard and a boat club. Another boatyard is located on the Assonet River in Berkley. It has a mooring capacity for approximately 15 boats and a slip capacity for 225 boats. Private yacht clubs also provide similar facilities. Their locations are also shown on Plate B-8.

HUMAN RESOURCES

According to the U. S. Bureau of the Census, 1974 Figures, the approximate population residing within the Taunton River Basin limits was 405,000. Based upon a basin area of 570 square miles, the population density of this area was approximately 710 persons per square mile. Only those towns with more than thirty percent of their land area within the basin are considered in detail in this section. Twenty-nine of the 43 communities at least partly within the basin meet this criteria. These communities contain estimated population densities as shown on Table B-13.

TABLE B-13

POPULATION & AREA OF MUNICIPALITIES

	<u>Area within Basin</u>	<u>Percent within Basin</u>	<u>Density</u>
Abington	8.9	91.5	1,237
Attleboro	7.5	48.8	1,196
Avon	3.6	29.1	1,217
Berkley	17.4	100.0	130
Bridgewater	28.1	100.0	433
Brockton	21.3	100.0	4,167
Dighton	18.5	71.1	214
East Bridgewater	17.7	100.0	483
Easton	29.4	100.0	419
Fall River	25.7	44.5	2,946
Foxborough	16.6	77.9	719
Freetown	31.2	91.3	124
Halifax	17.1	99.6	219
Hanson	9.1	65.9	471
Holbrook	1.8	20.3	1,613
Lakeville	35.6	100.0	148
Mansfield	19.5	89.2	492
Middleborough	54.7	61.5	194
Norton	29.4	100.0	340
Plainville	5.1	76.7	451
Plympton	11.4	68.6	82
Raynham	20.7	100.0	330
Sharon	7.9	44.6	524
Somerset	7.0	25.5	2,540
Stoughton	7.5	54.0	1,444
Taunton	48.6	100.0	925
West Bridgewater	15.8	100.0	462
Whitman	7.0	100.0	1,949
Wrentham	6.1	27.7	332

The main impact of the proposed flood management measures discussed in Section E would be felt in the vicinity of the cities of Taunton and Raynham.

Information was compiled regarding residents of the 26 communities previously mentioned. Data concerning nativity, education, income and employment skills are presented in Tables B-14 and B-15.

Early Development

The first settlers immigrated to the Taunton River Basin during the early 1600's from the established Plymouth and Massachusetts Bay Colonies. In 1636 a community in the vicinity of present day Taunton was established by a group of Puritans and Quakers. Nine years later in 1645, John Alden and Myles Standish led a group from Plymouth Colony the area of present day Brockton and Bridgewater to colonize land purchased from Massasoit, the friendly chief of the Wampanoag tribe. Groups split off from these early settlements to form their own, and by the end of the 17th century the majority of the present day towns had been founded.

Early settlers in this region were farmers, and each community was largely self-sufficient. Bog ore was found along streambanks throughout the region, and iron was manufactured as early as 1650. Iron production was one of the earliest forms of industrialization in the river basin and it continued to be significant until after the Revolutionary War. Accompanying this early development was the growth of shipbuilding, whaling, and fishing which occurred throughout the 18th century. This activity was concentrated along the lower reaches of the Taunton River and along the shores of Mt. Hope Bay.

Industrial activity was attracted to the area by the abundance of water power. Grist and saw mills began to appear during the late 1700's along many of the basin's rivers, and the early 1800's witnessed a substantial increase in the level of industrialization in the area. The regions of Abington, Brockton and Middleborough were major shoe production centers by the time of the Civil War, while jewelry was being manufactured in Norton and Plainville. The rise of these two fields coincided with the development of the apparel, leather and textile industries in other portions of the basin.

TABLE B-14

POPULATION PROFILE

NOTE: Data for Berkley and Plympton is unavailable; foreign born in Wrentham is also unavailable.

1. Total 25 years old and over. Source U.S. Census 1970.
2. 1969 Figures
3. For families & unrelated individuals
4. Total 16 years and older. Source U.S. Census 1970.

TABLE B-14
POPULATION PROFILE

High School or Equivalent or More	Completed Four or More Years of High School	Completed Four or More Years of College	Civilian Labor Force Unemployed	Per Capita Income \$	Median Income \$
12.4	41.7	1.7	2.7	1,284	11,714
11.8	34.7	1.8	2.7	1,287	11,714
12.3	34.7	1.7	2.7	1,191	11,847
12.1	4.7	4.1	3.7	2,908	9,231
12.1	3.9	1.2	4.1	1,974	8,794
12.1	34.7	8.7	4.7	1,329	9,794
12.3	43.2	1.8	3.1	1,110	11,154
12.5	69.3	14.1	2.4	1,211	9,315
8.8	10.6	4.3	1.2	2,177	11,778
12.5	34.1	18.6	3.2	1,192	10,900
11.3	33.3	4.6	2.1	2,948	9,310
12.3	47.6	4.3	2.4	2,787	9,431
12.3	44.3	8.8	4.8	2,906	10,571
12.3	46.1	8.0	3.9	1,021	11,230
12.0	12.5	1.0	2.7	1,172	9,286
12.3	31.1	10.7	3.0	1,123	9,967
12.1	3.8	6.7	6.0	2,883	8,313
12.1	35.0	9.8	1.9	2,851	11,315
12.3	36.3	8.1	1.1	2,982	10,272
12.3	38.5	11.2	3.3	1,569	11,293
12.8	61.7	43.7	2.7	4,290	14,009
11.8	30.3	9.3	4.1	1,118	10,941
12.3	63.8	8.7	4.5	2,824	8,408
10.7	28.6	3.0	4.2	2,862	5,789
12.3	45.7	1.8	2.2	1,081	10,124
12.2	40.8	6.0	1.9	2,182	10,078
12.1	32.6	10.2	1.9	1,425	8,607
12.2	34.8	12.6	3.8		

Note: foreign born in Wrentham is also unavailable.

U.S. Census 1970.

U.S. Census 1970.

TABLE B-15

INDUSTRY OF EMPLOYMENT
EXPRESSED AS PERCENTAGE OF

Town	Employment 1975	Percentage 1975	Employment 1970	Percentage 1970	Percentage 1970	Percentage 1970
Andover	14	0.1	14	0.1	0.1	13.0
Andover	14	0.1	14	0.1	0.1	4.0
Andover	14	0.1	14	0.1	0.1	11.0
Andover	14	0.1	14	0.1	0.1	13.0
Andover	14	0.1	14	0.1	0.1	23.0
Andover	14	0.1	14	0.1	0.1	27.0
Andover	14	0.1	14	0.1	0.1	0.1
Andover	14	0.1	14	0.1	0.1	18.2
Andover	14	0.1	14	0.1	0.1	13.0
Andover	14	0.1	14	0.1	0.1	14.4
Andover	14	0.1	14	0.1	0.1	11.5
Andover	14	0.1	14	0.1	0.1	14.1
Andover	14	0.1	14	0.1	0.1	23.4
Andover	14	0.1	14	0.1	0.1	23.0
Andover	14	0.1	14	0.1	0.1	40.1
Andover	14	0.1	14	0.1	0.1	17.0
Andover	14	0.1	14	0.1	0.1	23.4
Andover	14	0.1	14	0.1	0.1	21.1
Andover	14	0.1	14	0.1	0.1	19.1
Andover	14	0.1	14	0.1	0.1	14.1
Andover	14	0.1	14	0.1	0.1	1.0
Andover	14	0.1	14	0.1	0.1	41.1
Andover	14	0.1	14	0.1	0.1	16.0
Andover	14	0.1	14	0.1	0.1	28.1
Andover	14	0.1	14	0.1	0.1	21.0
Andover	14	0.1	14	0.1	0.1	16.1
Andover	14	0.1	14	0.1	0.1	38.1
Andover	14	0.1	14	0.1	0.1	23.0
Andover	14	0.1	14	0.1	0.1	14.1

1. Certain figures in these categories were not available due to the size of the town.

Sources: Employment as reported to the Division of Employment Security, State of Massachusetts, 1975
and to the U.S. Bureau of Census, 1970.

TABLE B-15

INDUSTRY OF EMPLOYED WORKERS
EXPRESSED AS PERCENTAGE OF TOTAL EMPLOYED

Manufacturing	Trans- portation Equipment	Wholesale & Retail Trade	Finance, Insurance, Real Estate	Government	Education	Health	Other
12.5	1.7	22.5	3.2	11.0	21.0	11.0	3.1
11.1	1.6	24.2	2.9	8.0	24.4	12.8	3.4
23.0	1.8	31.3	1.1	6.4	11.0	8.0	
16.0	1.7	8.0	9.0				
27.0	1.1	23.3	2.9	3.8	21.4	8.4	
18.0	1.0	27.1	3.4	10.1	11.8	12.0	4.0
15.8	1.4	10.7	11.7	11.1	32.8	22.0	
13.8	1.8	18.2	9.4	10.3	16.0	10.0	
13.0	4.3	13.8	1.9	19.7	20.4	18.0	6.8
41.0	1.0	13.3	3.3	14.4	12.1	1.3	3.1
58.7	1.8	11.0	1.4	1.0	17.7	8.0	3.1
24.8	1.0	14.7	1.3	18.7	24.0	9.7	
22.7	10.0	13.4	1.9	1.0	34.1	20.1	
25.0	10.0	23.0	4.7	2.7	25.4	11.0	
15.0	10.7	10.1	0.9	1.0	23.8	8.0	3.3
10.8	1.0	17.0	1.6	22.2	33.7	15.0	
36.4	9.3	23.8	2.0	11.0	17.2	10.0	
21.4	3.1	21.3	3.6	13.3	21.2	6.0	3.1
22.3	9.1	19.8	0.3	22.0	11.6	21.7	
48.7	9.8	14.7	1.1	7.1	9.1	11.8	
88.8	0.3	1.4	0.2	5.8			
2.1	3.1	41.2	3.1	13.4	22.4	11.0	
5.7	1.8	16.0	2.0	12.2	29.4	24.1	5.8
4.2	10.1	28.1	3.9	9.3	24.6	11.6	1.0
23.5	3.6	21.4	1.9	18.2	16.2	6.5	4.9
33.4	2.8	16.1	2.7	11.3	17.8	6.7	6.9
27.6	3.3	38.8	1.0	1.3	15.7		
21.9	8.1	23.6	2.4	6.1	18.8	9.6	5.5
24.7	2.2	14.9	1.1	10.1	28.9	12.8	

, 1975

Later Development And Growth

The region experienced a period of recession during the early to mid 1900's and the apparel, shoe and textile industries in the Northeast declined. The response to this was diversification of its economic base.

During the 1960's employment in the Taunton Basin increased by 21,000 jobs. The towns of Plainville, Sharon and Stoughton are not included in the figures cited in this paragraph. One of every four of these jobs was in retail trade activities and of these, 40 percent were in Brockton, largely because a major shopping center was constructed there. The increased population demanded more public services, such as utilities and private education, and this accounted for one out of every three new jobs. Government positions accounted for another third of the new jobs. Manufacturing employment declined by about 2,400 jobs or 4.8%; yet this employer of 50,354 people in 1970 remained the single most important economic sector in the region accounting for as many as one in every 2.6 jobs overall.

Table B-15 details the major employment groups in each community. With the exception of Fall River and Taunton, population growth throughout the basin has been rapid. Fall River is the only town in the region which has experienced a negative rate of growth over the past 30 years, while Taunton has maintained a slightly positive growth rate. These rapid growth rates are projected to continue into the future because of the trend toward suburbanization, the good access of the area to the employment centers of Boston and Providence and the availability of land around these cities. Table B-16 details each community's population and its past and projected rates of growth.

Land use is detailed in Table B-17. As would be expected in a rapidly growing area, it depicts a great deal of urbanization during the 20-year period 1951-1971. Industrial, commercial, residential, transportation and open and public uses all increased with the exception of industrial land in Brockton. It declined by 22 percent during this period. Despite the urbanization which has occurred, the region remains largely undeveloped and the majority of the basin is classified as forest land. Other major uses are agriculture or open land, residential and wetlands. Industrial and commercial development, although increasing greatly in percentage terms, is still a rather small proportion of the total land use.

TABLE B-16
COMMUNITY POPULATION⁽¹⁾

Town	1940	1950	1960	1970	1980	1990
Abington ⁽³⁾	5,708 -2.8	7,152 25.3	10,707 48.3	12,334 15.2	13,107 6.3	14,199 8.3
Attleboro ⁽⁴⁾	22,071	23,908 8.3	27,118 13.4	32,967 21.6	37,121 12.5	45,231 21.9
Avon ⁽²⁾	2,335 -3.3	2,666 14.2	4,301 61.3	5,200 20.9	5,700 9.6	6,000 5.3
Berkley ⁽⁴⁾	1,130 0.9	1,284 13.6	1,609 25.3	2,127 32.2	2,500 17.5	2,800 12.0
Bridgewater ⁽¹⁾	8,902 -1.7	9,512 6.9	10,270 8.4	11,800 15.4	12,500 5.9	13,500 8.0
Brockton ⁽²⁾	62,343 -2.3	62,860 0.8	72,811 15.8	84,440 22.1	90,000 6.6	95,000 5.6
Dighton ⁽⁴⁾	2,983 -5.2	2,950 -1.1	3,769 27.8	4,000 6.1	4,500 12.5	5,000 11.1
E. Bridgewater ⁽²⁾	3,832 6.7	4,412 15.1	6,132 39.1	8,000 30.8	9,000 12.5	10,000 11.1
Easton ⁽²⁾	5,135 -3.1	6,244 21.6	9,078 45.4	12,157 33.9	15,000 23.4	18,000 20.0
Fall River ⁽⁴⁾	115,428 0.1	111,963 -3.0	99,942 -10.7	96,898 -3.1	90,000 -7.1	85,000 -5.6
Foxborough ⁽²⁾	6,303 17.9	7,030 11.5	10,136 44.2	14,218 40.3	17,000 19.6	20,000 17.6
Freetown ⁽³⁾	1,584 -4.3	2,104 32.8	3,039 44.4	4,200 40.5	5,000 19.0	6,000 20.0
Halifax ⁽²⁾	867 19.1	944 8.9	1,599 69.4	3,537 121.2	5,000 41.2	6,000 20.0
Hanson ⁽²⁾	2,570 17.7	3,264 27.0	4,370 33.9	7,148 63.3	8,800 23.3	11,000 25.0
Holbrook ⁽²⁾	4,004	5,341 33.4	10,104 89.2	11,770 16.5	12,600 7.0	15,500 23.0
Lakeville ⁽⁴⁾	1,780 13.1	2,066 16.1	3,209 55.3	4,370 36.4	5,100 16.4	6,000 17.6
Mansfield ⁽⁴⁾	6,530 2.5	7,184 10.0	7,773 8.2	9,939 27.9	15,000 50.0	18,000 20.0
Middleborough ⁽⁴⁾	9,032 4.9	12,164 34.5	11,065 -9.0	13,607 23.0	16,000 17.0	17,500 9.4
Norton ⁽⁴⁾	3,107 13.5	4,401 41.6	6,818 54.9	9,487 39.1	13,200 39.1	15,500 17.4
Plainville ⁽²⁾	1,302 -17.8	2,088 60.4	3,810 82.5	4,953 30.0	6,700 35.3	7,000 4.5
Plympton ⁽⁴⁾	532 4.1	697 31.0	821 17.8	1,224 49.1	2,450 100.2	3,050 24.5
Raynham ⁽⁴⁾	2,141 0.2	2,426 13.3	4,150 71.1	6,705 61.6	10,000 48.6	14,000 40.0
Sharon ⁽²⁾	3,737 11.5	4,847 29.7	10,070 107.7	12,367 22.8	16,000 29.4	18,300 14.4
Somerset ⁽⁴⁾	5,873 8.8	8,566 45.8	12,196 46.5	18,088 48.3	22,150 22.5	23,550 6.3
Stoughton ⁽²⁾	8,632	11,146	16,328	23,400	28,000	32,000

Bridgewater ⁽¹⁾	8,902 -1.7	9,512 6.9	10,276 7.4	11,829 15.1	16,909 42.9	21,290 24.6
Brockton ⁽²⁾	62,343 -2.3	62,869 0.8	72,811 15.8	84,946 22.3	101,000 19.1	117,000 16.0
Dighton ⁽⁴⁾	2,985 -4.2	2,989 -1.1	3,769 27.8	4,667 23.7	5,600 19.9	6,600 12.8
El. Bridgewater ⁽²⁾	5,832 6.7	4,412 15.1	6,139 39.1	8,547 38.7	11,000 28.7	13,700 20.0
Easton ⁽²⁾	5,135 -3.1	6,244 21.6	9,078 45.4	12,157 33.7	15,000 24.0	18,100 21.0
Fall River ⁽⁴⁾	115,428 0.1	111,963 -3.0	99,942 -10.7	96,896 -3.1	82,000 -15.5	68,700 -16.0
Foxborough ⁽²⁾	6,303 17.2	7,030 11.5	10,136 44.2	14,218 40.7	18,000 26.6	22,400 24.4
Freetown ⁽³⁾	1,584 -4.3	2,104 32.8	3,039 44.4	4,237 40.8	5,700 34.2	7,500 29.0
Halifax ⁽²⁾	867 19.1	944 8.9	1,599 69.4	3,537 121.2	6,700 81.2	10,800 60.8
Hanson ⁽²⁾	2,570 17.7	3,264 27.0	4,370 33.9	7,148 63.6	8,800 23.9	11,700 33.0
Holbrook ⁽²⁾	4,004 33.4	5,341 33.4	10,104 89.2	11,775 16.5	12,600 7.3	16,500 24.0
Lakeville ⁽⁴⁾	1,780 13.1	2,066 16.1	3,209 55.3	4,376 36.4	5,100 16.4	7,200 18.9
Mansfield ⁽⁴⁾	6,530 2.5	7,184 10.0	7,773 8.2	9,959 27.9	15,980 60.0	18,000 17.0
Middleborough ⁽⁴⁾	9,032 4.9	10,164 12.5	11,065 8.9	13,607 23.0	16,000 17.6	17,550 9.7
Norton ⁽⁴⁾	3,107 13.5	4,401 41.6	6,818 54.9	9,487 39.1	13,200 39.1	16,500 17.4
Plainville ⁽²⁾	1,302 -17.8	2,088 60.4	3,810 82.5	4,953 30.0	6,700 35.3	7,500 11.4
Plympton ⁽⁴⁾	532 4.1	697 31.0	821 17.8	1,224 49.1	2,450 100.2	3,550 44.9
Raynham ⁽⁴⁾	2,141 0.2	2,426 13.3	4,150 71.1	6,705 61.6	10,900 62.6	14,500 33.9
Sharon ⁽²⁾	3,737 11.5	4,847 29.7	10,070 107.7	12,367 22.8	16,000 29.4	18,300 14.4
Somerset ⁽⁴⁾	5,873 8.8	8,566 45.8	12,196 46.5	18,088 48.3	22,150 22.5	23,550 6.3
Stoughton ⁽²⁾	8,632 5.2	11,146 29.1	16,328 46.4	23,459 43.7	28,000 19.4	31,800 13.6
Taunton ⁽⁴⁾	37,395 0.1	40,109 7.3	41,132 2.6	43,756 6.4	43,550 -0.2	44,000 1.5
W. Bridgewater ⁽²⁾	3,247 1.3	4,059 25.0	5,061 24.7	7,152 41.3	7,200 0.7	13,800 80.0
Whitman ⁽²⁾	7,759 1.6	8,413 8.4	10,485 24.6	13,059 24.5	14,200 8.7	17,100 20.4
Wrentham ⁽²⁾	3,330 40.4	4,674 40.4	6,685 43.0	7,515 13.4	8,200 12.1	11,900 45.1

Footnotes for Table B-16

Projections are based upon:

1. Upper case figure represents population size; lower case figure represents percent change from previous year.
2. Metropolitan Area Planning Council Data.
3. Old Colony Planning Council Data.
4. Southeastern Regional Planning and Economic Development District Data Booklets, 1971 by Office of Planning and Program Coordination, Commonwealth of Massachusetts.

Source: Population figures U.S. Census, 1970, 1960, 1950, 1940.

Footnotes to Table B-17

1. Upper Case Figure
2. Lower Case Figure
3. There was no land classified under this use in 1951. Therefore, no comparison is possible.
4. These figures were derived from a combination of SENE and University of Massachusetts (MacConnell) studies.
5. These categories did not exist in 1951 data and therefore, no comparison is possible.
6. 1972 use base.
7. This percentage change figure represents the change for aggregated industrial and commercial land uses. The 1951 data for these towns was not broken down.
8.
Source: MacConnell Studies and SENE Study.

TRANSPORTATION FACILITIES

The communities in the Taunton River Basin have access to both the Providence and the Boston transportation networks -- a very extensive set of transportation services.

Highway - Route 24 is the major highway through this region. It runs north to south, nearly bisecting the basin, and connects Route 128 to Interstate 195. Route 24 also connects with Route 140, leading to Buzzards Bay. Route 44 bisects the river basin from east to west. It connects Providence in the west with Plymouth in the east. In the northwestern corner of the basin Interstate 495, the outer loop around Boston, meets Interstate 95, the major north-south highway on the East Coast. The basin's secondary system of roads is well developed.

This area is also well serviced by the many contract trucking firms having major terminals in Providence and Boston. Several bus lines are franchised to operate in the river basin. They include the Almedia Bus Line, Inc., the Massachusetts Bay Transportation Authority and the Short Line, Inc. These buses schedule both intracity and intrastate routes, while Boston and Providence provide extensive interstate bus travel. Plate B-9 depicts all major highways, the intrastate system and the major railroad lines within the Taunton Basin.

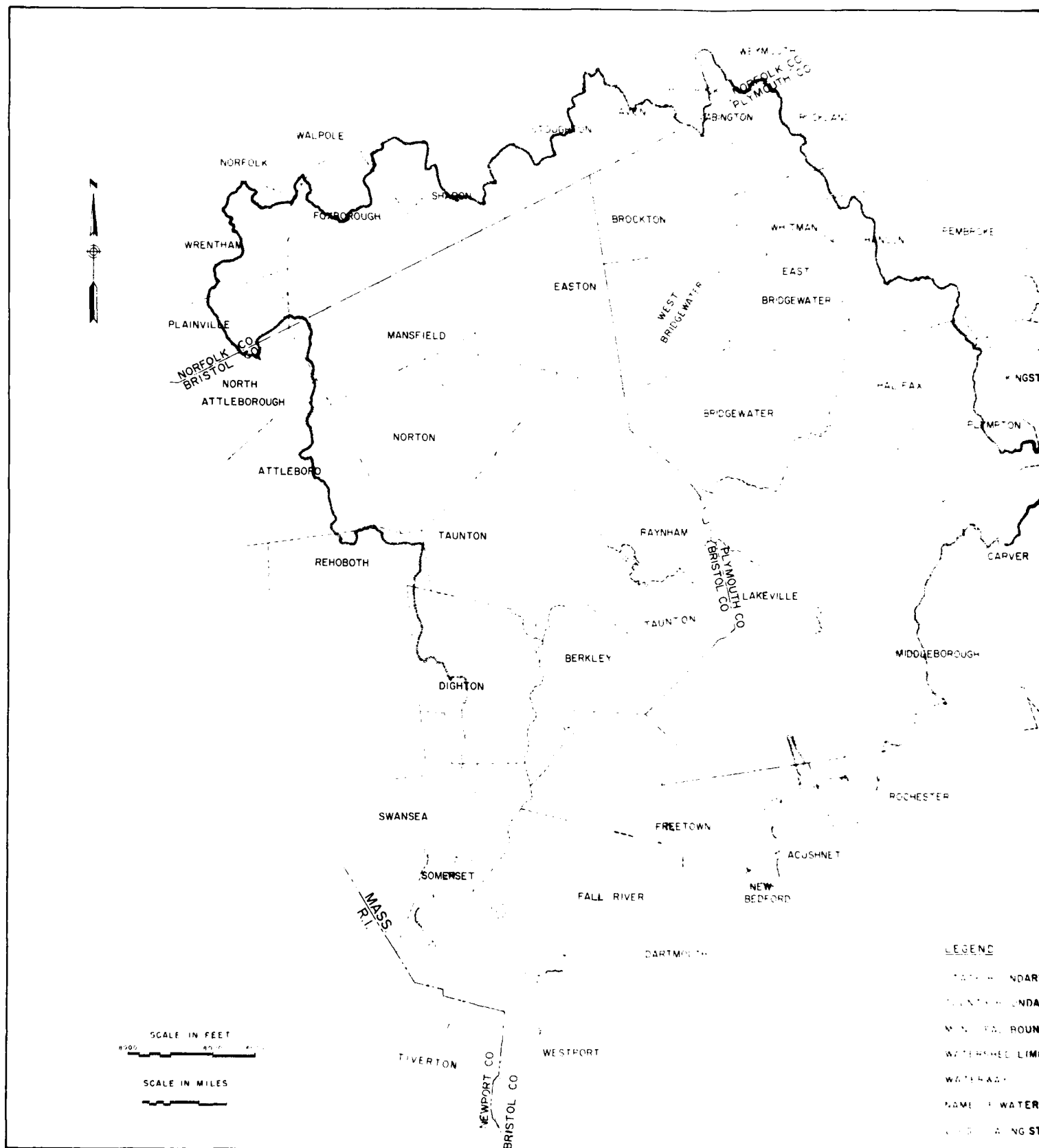
Railroad - Amtrak passenger service is available in both Boston and Providence, but not locally. Conrail freight handles fully loaded cars and provides other specific services in Boston and Providence.

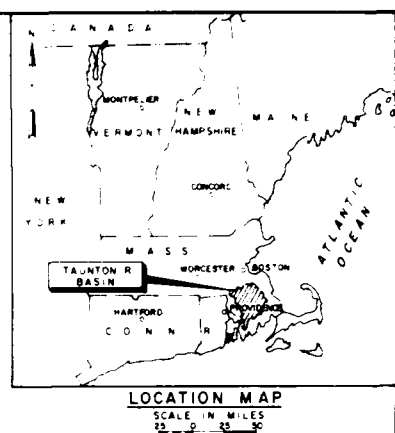
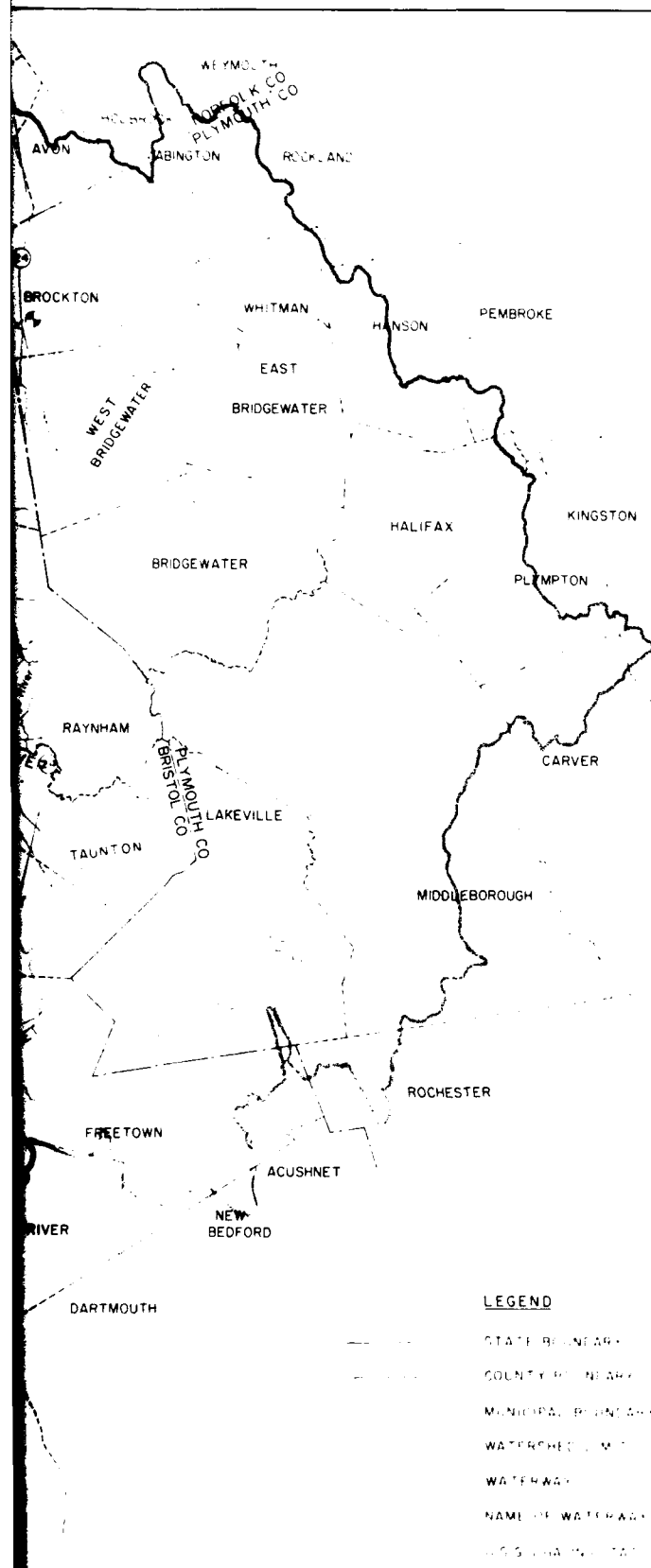
Air - The river basin has access to several smaller airports including Fall River Municipal, Mansfield Municipal, Taunton Municipal and Norwood Airports. New Bedford Airport offers limited charter air service while Logan International Airport in Boston provides a full complement of needed services.

Water - The services of Boston Harbor and Providence Harbor are available as well as those of Fall River Harbor. The latter has good facilities located in Mt. Hope Bay and along the Taunton River with a controlling depth of 30-35 feet.

FUTURE DEVELOPMENT

The continuing population growth projected for this area will place increased demands upon local services. Also, the completion of I-495 from its junction with I-95 to the junction of Routes 24 and 25 will encourage growth. Most of the communities in the Taunton Planning Area will experience significant development over the next 20 years.





HIGHWAY SYMBOLS

- U.S. INTERSTATE
- U.S. ROUTE
- STATE ROAD

LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- WATERSHED LIMIT
- WATERWAY
- NAME OF WATERWAY
- U.S. HIGHWAY ROUTE

WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R 1

ROAD SYSTEMS

DEPARTMENT OF THE ARMY
WATER RESOURCES DIVISION
WASHINGTON, D.C.

SECTION C

Flood Problems

and

Flood Management Needs

AD-A122 993

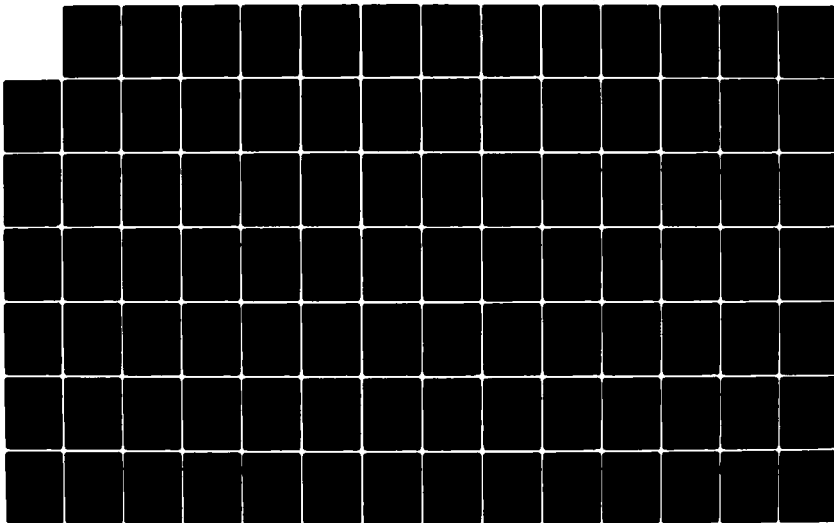
ASSESSMENT OF THE FLOOD PROBLEMS OF THE TAUNTON RIVER
BASIN MASSACHUSETTS(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV DEC 78

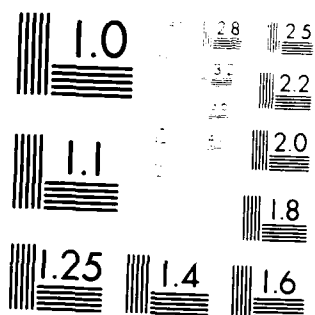
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U.S. GOVERNMENT PRINTING OFFICE: 1963

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FLOOD PROBLEMS

This section describes the problems and needs of the basin, their magnitude, the status of existing plans and improvements and improvements that local interests desire. It also presents hydrologic, economic and flood analyses for the basin.

EXTENT AND CHARACTERISTICS OF FLOOD AREAS

General - Flooding in the basin can occur at any time of the year. Along the main stem of the Taunton River, flooding can be caused by either storm rainfall and runoff attributed to the upstream drainage area or tidal flooding such as that caused by a hurricane or a combination of both. Antecedent conditions in this basin are extremely important in determining whether or not widespread flooding will occur. The watershed contains many large swamps, more than 32,700 acres. The natural valley storage capacity of these wetlands is tremendous. Assuming each swamp can store a minimum of 3 feet of water before the banks overflow, about 98,000 acre feet of floodwater storage is available. The location of these swamps also plays a key role. The Hockomock Swamp covers more than 6,500 acres, and it can easily hold an average depth of 5 feet without allowing flooding. This is equal to over 32,500 acre-feet of storage, larger than most of the flood control reservoirs that this Division has built solely for downstream flood protection. The upstream drainage area is however, relatively small -- 32.7 square miles. The true effectiveness of this large flood water storage area is never realized as only a third of its available storage is used. The importance of these swamps -- the Hockomock, Great Cedar Swamp in Middleborough, Great Cedar Swamp in Hanson, Cedar Swamp River, Turkey Swamp, Hemlock Swamp, Bolton Cedar Swamp, the swamps along the Canoe and Cotley Rivers, the Pine Swamp and Chartley Brook -- is clearly demonstrated by the insignificant flooding in the Taunton Basin from rainfall-runoff relationships. If these wetlands, along with numerous smaller ones, remain as they are now, future flooding will be very limited, even after major storms. Some urban localities will receive damage, but it will be attributable to previous filling-in of swamp areas or to poor local drainage situations caused by inadequate culvert or bridge cross sectional areas or openings.

Town River - The Town River begins in the headwaters of Dorchester and Quest Brooks in Stoughton and Easton, Massachusetts. At its confluence with the Matfield River it has a drainage area of 60 square miles

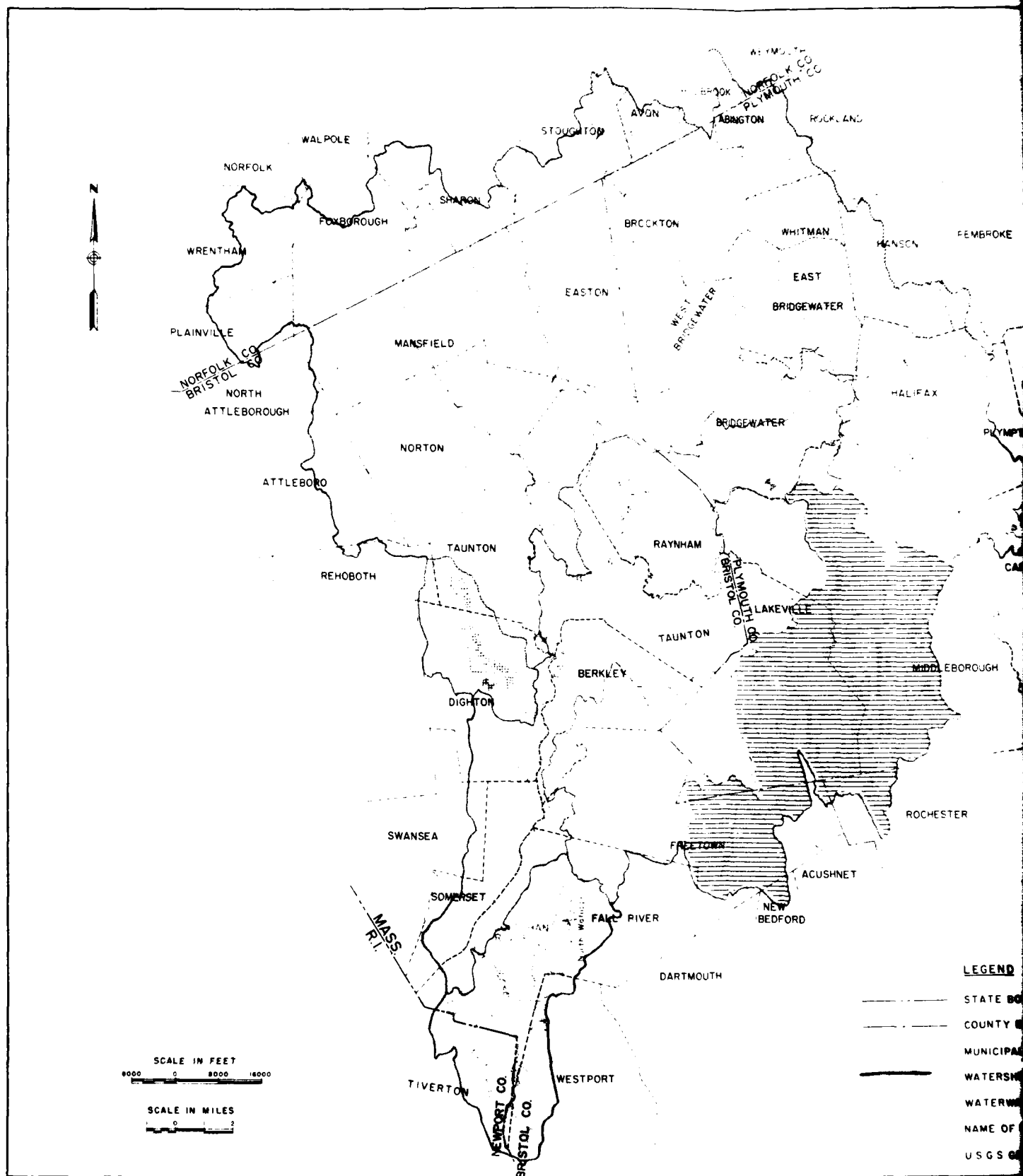
of which an estimated 31.7 percent or 19 square miles are swamp or wetlands. The overall length of the river is approximately 22 miles measured to the furthest upstream point of its headwaters. Principal streams in the upper part of the basin above the Hockomock Swamp average about 17 feet per mile drop while the main stem of the Town River below the Hockomock Swamp averages about 5 feet per mile. The Hockomock Swamp has a surface area of approximately 12 square miles and is drained principally by the Town River. Approximately 28 percent is drained by the Mill River, another tributary of the Taunton. The size and location of this swamp results in considerable attenuation of flood peaks on the Town River and subsequently the Taunton.

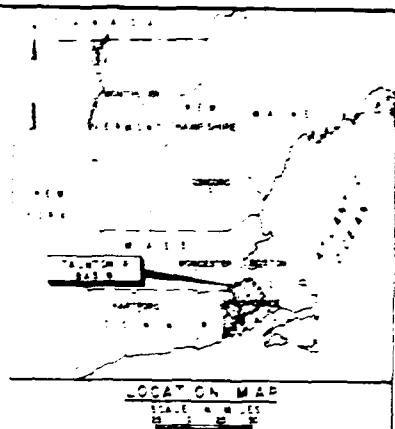
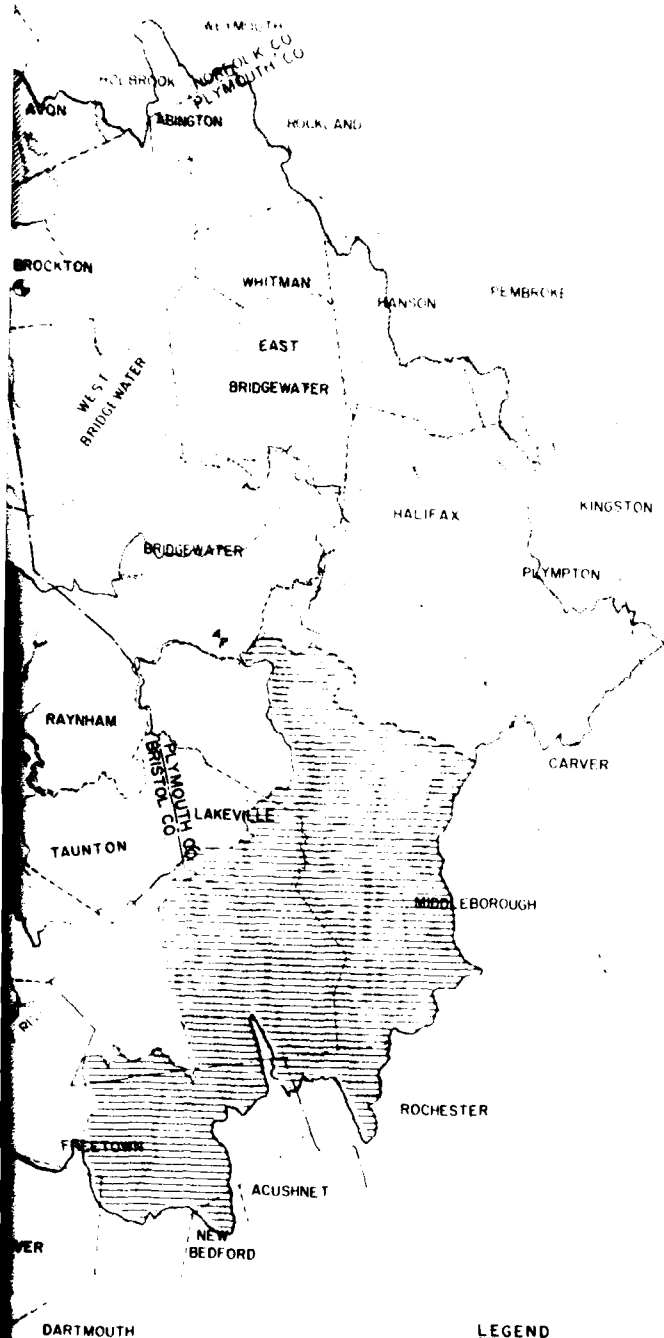
Potential damages to existing buildings along the Town River are minor. The only area that would receive substantial losses from a major flood is the village of Stanley in Bridgewater, where several industrial concerns are located along the river's bank. A downstream dam impounds water at such a height that the culverts under Wall Street remain full at all times. During periods of high runoff, these culverts could not pass the entire flow and would back up the flood waters until the roads were overtopped. At this point damages to these industrial properties would begin. Several residences would also suffer substantial losses. An extremely rare flood event would damage several other residential structures and small commercial establishments that are located randomly throughout the river's reach.

Flood problems are known to exist along a small portion of Washington Street in Easton and an area upstream of the new Brockton High School-West Meadow Brook area, where portions of the brook flow underground through culverts. These flood problems are caused by inadequate local drainage conveyances.

Matfield River - The Matfield River, which joins the Town to form the Taunton, has its beginnings in the headwaters of the Salisbury Plain and Shumatuscant Rivers in the area north and east of Brockton. The river is approximately 23.5 miles long and averages a 5 foot per mile drop. At its confluence with the Town, the point at which the Taunton River originates, the Matfield has a total drainage area of 78 square miles of which an estimated 14 percent or approximately 11 square miles is swamp or wetlands. This, coupled with the shallow gradient, tends to retard and reduce floodflow peaks.

This watershed, along with the Quequechan, is the most urbanized in the basin. As can be expected with most urbanized areas, severe en-





DRAINAGE AREAS

- ASSONET
- LOCAL
- WATERFLO
- WELL
- NEWASKET
- QUEQUEHAN
- SEGREGANSET
- THREEMILE
- TOWN
- WINNETUXET

LEGEND

- STATE BOUNDARY
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- WATERSHED LIMIT
- WATERWAY
- NAME OF WATERWAY
- U.S.G.S. GAGING STATION

WATER RESOURCES MANAGEMENT REPORT
 TAUNTON RIVER BASIN
 MASS. - R.I.
**TAUNTON RIVER
 SUB BASINS**
 DEPARTMENT OF THE ARMY
 NEW ENGLAND DIVISION, CORPS OF ENGINEERS
 WALTHAM, MASS

croachment of the flood plains has taken place. This is especially evident along Salisbury Plain Brook where minor flooding has occurred fairly frequently along the upper reaches. Damages were most notably in August 1955 and March 1968. The problems are attributable to inadequate bridge openings, constrictions in the channel, inadequate channel size, and the rapid urbanization in the upstream area that has significantly modified the local drainage conveyances. The Salisbury Plain Brook was studied by the Corps of Engineers after the 1968 event to determine whether Federal participation in constructing structural improvements was warranted. No major structural improvements have been made on the stream to date.

Another problem area is located along the Salisbury Plain River where heavy damage can be experienced by industrial and commercial properties.

Other localized flood problems exist along Trout Brook, Beaver Brook and the Matfield River, where damages would be inflicted upon individual ownerships or small groups of structures.

Numerous swamps in the Satucket River subbasin are still in their natural state. These, along with the abundant lakes and cranberry bogs, have helped retard flood flows and have minimized downstream damages from this portion of the Matfield.

Winnetuxet River - The Winnetuxet River rises in the northern section of Carver, Massachusetts on the eastern edge of the Taunton River drainage basin. It has a length of approximately 13 miles and a drainage area of about 39 square miles at its confluence with the Taunton. Within its measured length the river meanders considerably and its normal flow channel is much longer than 13 miles. The overall slope of the river is about 10 feet per mile with most of its fall occurring in the upper portions of the watershed. The Winnetuxet and its tributaries flow through a series of swamps, ponds and cranberry bogs in the upper portions of the watershed, and they all tend to have an attenuating effect on runoff peaks. The lower 6-mile reach of the river meanders along the northern edge of the Great Cedar Swamp, where it falls only 12 feet. Of the total drainage area of the Winnetuxet approximately 36 percent or 14 square miles is swamp or wetlands.

This watershed, along with the Assonet Cedar Swamp, is the least populated basin in the Taunton River System. There does not appear to be any residential or commercial area in the sub-basin that would experience substantial losses from even the most infrequent flood event.

This does not include problems associated with inadequate local drainage conveyances where small culvert openings can possibly cause small brooks or streams to overflow their banks and inundate nearby homes. Even under this situation losses would be minor.

Nemasket River - The Nemasket River begins at the outfall to Assawompsett Pond, the largest body of water in the complex known as the Lakeville Ponds. The Nemasket has a total drainage area of about 70 square miles of which 67 percent or approximately 47 square miles is highly regulated by the five interconnected ponds making up the Lakeville complex. The Nemasket meanders in a northerly direction for approximately 11 miles before joining the Taunton River in Middleboro, Massachusetts. The river drops an average 2.6 feet per mile throughout its length. The other ponds in the Lakeville complex are Pocksha, Great Quittacas, Little Quittacas and Long. Only the latter is used for unrestricted recreational purposes; the others are a direct water supply source for Taunton and New Bedford. Except for the municipality of Middleborough, the basin is very rural. It, too, has numerous swamps and very little damage would be experienced during a major flood. The small damage zone would consist of an industrial-commercial area in Middleboro, and damages here would be minor. Little development has taken place within the flood plain.

Mill River - The Mill River rises in the southern section of Sharon, Massachusetts and is known first as the Canoe River and then the Snake before it is finally called the Mill. The Canoe portion flows southerly, eventually discharging into Winnecunnet Pond. It is about 14 miles long and falls approximately 200 feet. Mulberry Meadow Brook, approximately 4 miles long and with a slope of 6 feet per mile, is a tributary of the Mill and it also flows into Winnecunnet Pond. From the outfall of Winnecunnet Pond the river, now known as the Snake, flows first in an easterly direction then turns southerly before emptying into Lake Sabbatia. On its travels the Snake passes through the lower southwest corner of the Great Hockomock Swamp. The overall length of the Snake is 3 miles and its' slope is 1.3 feet per mile. The location of the swamp and flat gradient of the Snake tend to have an attenuating effect on runoff from the upper portion of the Mill River watershed. The outfall from Lake Sabbatia is known as the Mill River and flows in a southerly direction through the city of Taunton before joining the Taunton River just downstream of the Route 140 highway bridge and upstream of the industrial area of the city. In its reach through the city, the Mill River is highly confined between walls and at various locations passes beneath structures. The total drainage area is about 43 square miles, of which some 15 percent or 6.5 square miles is non contributing wetlands. The

overall length of the Mill from its uppermost reach to its outfall is about 24 miles, and its average slope is approximately 9.5 feet per mile.

Moderate to heavy flood losses would be experienced in downtown Taunton from either a major flood or a hurricane because portions of the lower reaches are tidal. Areas receiving the damages are located on both sides of the river and, except for the center of town, are scattered throughout its length. Several industrial areas received slight damages from the March 1968 flood. However, there was a threat of several upstream dams failing and the downstream areas were evacuated as a precaution. Actual physical losses from the 1968 flood were not widespread. Although several other areas were threatened with flooding, the peak flows receded before significant damages were reported. The residential area surrounding Lake Sabbatia received damages, but they were of the nuisance and discomfort type such as flooded basements and roads.

Flooding upstream of Lake Sabbatia is not a serious matter. A number of swamps still exist on the Canoe and Snake Rivers, and they help reduce downstream flooding. Neither would cause significant losses in a major flood event. Mulberry Meadow Brook's upstream drainage area does not have a swamp system comparable to the Canoe or Snake systems; it does not have appreciable development in the flood plain either.

Threemile River - The headwaters of the Threemile River are in the towns of Foxborough, Plainville and Sharon, Massachusetts in the extreme northwest portion of the Taunton River basin. Flowing southerly, the Wading and Rumford Rivers join in the town of Norton to form the Threemile River. Continuing south the Threemile eventually meets the Taunton River at the Taunton-Dighton town line. Of a total drainage area of approximately 81 square miles, about 16 percent or 14 square miles is controlled by wetlands. The overall length of the river from its mouth to its farthest upstream point is about 28 miles and it averages a drop of 7.4 feet per mile.

The mainstem meanders across wooded and swampy areas for most of its length. At two nearby locations, however, recent flooding has occurred. These sites are at the Raytheon Co. and a small complex consisting of the Harodite Company, a post office and a cleaners. All suffered relatively minor damages from the March 1968 flood; most were attributable to clean up operations. The 100-year flood would add 1 to 2 feet of additional height of flood waters to the March 1968 event, and the Raytheon Complex would suffer significant losses with

about 3 feet of water above the first floor. The Harodite Company would be at the point where water might enter their manufacturing floors. Thus, losses could be significant. During floods larger than a 100-year event, major losses would be received.

Along the Wading River in the village of Chartley, a manufacturing plant and a grocery store would receive damages from a flood with a frequency of less than 100 years. Downstream, portions of another large manufacturing plant, Defiance Bleaching Company, would receive damages from a similar type event. Except for several homes, there do not appear to be any other areas that would be damaged by the 100-year flood along this portion of the watershed.

Above the Norton Reservoir, an emergency water supply lake used extensively for contact recreation, damages from a major flood are minimal. New residential housing has been constructed near sub-tributaries, but any damages inflicted there would be minor. Industries have also located in the upstream area, but they appear to be out of any flood threat situation. Norton Reservoir has many summer camps, year-round homes and trailer parks located on its shores. Some of these homes have recently been flooded. However, a new emergency spillway has been constructed at the outlet structure which should eliminate some past flooding by lowering the water surface in the reservoir during periods of floods. Future flooding of some of these homes is still possible, but it would take a major event since a limited drainage area exists upstream and the lake itself has a large surface area. Chances of severe flooding appear to be very remote.

Downstream of the reservoir's outlet structure, the river flows through wooded lands until it merges with the Wading River. Downtown Norton, consisting mainly of Wheaton College, has a local drainage problem.

Assonet-Cedar Swamp River - This river system is actually one river that changes names at the Freetown-Lakeville town boundary. It has a fall of 87 feet in its length of 10.9 miles. The Assonet River is tidal under normal flows up to the Route 24 bridge crossing. The coastline here is relatively undeveloped. Even with the most infrequent tidal storm only a few residences would be damaged. Upstream of the Route 24 crossing little development has infringed upon the flood plain. This watershed along with the Winnetuxet, is the least developed in the Taunton River Basin. Few damages, even from a Standard Project Flood, would be received by existing developments in this basin.

Quequechan River - The Quequechan River merges with the Taunton River at Battleship Cove in Fall River. Other than a 500-foot stretch of channel at the Cove, the river flows through underground culverts until it reaches a lake complex made up of North and South Watuppa Ponds and a ponding area caused by a controlling headworks to the culvert system. The banks of South Watuppa Pond are used for recreation while many homes and industrial complexes are sited along the backwater pond. North Watuppa Pond, a large water supply lake, is also connected to this complex. Because of the combined large surface areas of the lakes and the limited upstream drainage areas, flooding of the shoreside structures is very unlikely since the additional volume of floodwaters can easily be stored in the pond system. Upstream of these ponds, only a few residences are located in the various flood plains.

Taunton River - The mainstem of the Taunton River is extremely flat, falling only 22 feet from Paper Mill Village in Bridgewater, the merging point of the Town and Matfield Rivers, to Mount Hope Bay -- a distance of more than 38 miles. The reach above the former State Farm flow gaging station in Bridgewater is relatively flat and the drainage area at the gage is 260 square miles, of which an estimated 17 percent or 44 square miles is swamp or wetland. These wetlands tend to have a retarding effect on runoff from the upper watershed with the swamps acting much like flood control reservoirs.

From East Taunton, where normal tide influence becomes negligible, upstream to Paper Mill Village the riverbanks are virtually uninhabited. Damages to structures in this river reach would be minimal even under the Standard Project Flood condition, although some erosion and crop loss damages would be received. The reach downstream from East Taunton to the Route 24 bridge crossing is also relatively unsettled and losses here would be minimal. Downstream of the route 24 bridge development both in and out of the flood plain becomes rather heavy, especially on the right side (as one looks downstream). Significant to severe flood damages have been received here in the recent storm of 1968 and the hurricanes of 1938 and 1954. As mentioned earlier in Section A, a hurricane report for the lower portions of the Taunton River was prepared by this office because of the heavy losses from the two hurricanes. The City of Taunton was not included in this earlier analysis, although it is very susceptible to tidal flooding, but heavy damages were received throughout the other study areas. Little new growth has occurred within the 100-year flood limits. As current zoning criteria uses this as a minimum flood design level, many new developments have been built at or slightly above this level.

Thus, if the effects of a greater than 100-year hurricane were felt along the main stem, losses would border on the catastrophic in Fall River and Taunton with heavy damages in the remaining tidal towns bordering the Taunton River. Fortunately, such an event is not a common occurrence, but it should be planned for as a realistic problem caused by future development in marginal areas.

Many small tributaries not previously discussed enter the Taunton River. Some of these are the Segregansett and Forge Rivers, Cotley and Muddy Cove Brooks. Most of these watercourses present a minor flood threat owing to inadequate local drainage systems. A major hurricane could cause significant flooding, since all the areas surrounding these streams are very flat and have a relatively low ground elevation.

Structures along lower Cobb Brook, a 3-square mile watershed in the city of Taunton, suffer heavy damages frequently. These occur when the Taunton River is at a higher level than normal and heavy localized rains hit the watershed. As it is heavily urbanized, the rainwater runs off quickly over the paved or improved areas and enters the brook system. It then flows through undersized road culverts causing backups until the roads are breached. The brook flows through underground conduits for its lower 500 feet. Because of increased pressure heads generated by high tide levels and the high velocity flood waters trying to enter the culvert system, water backs up through floor drains and also flows over the entrance to the culvert system, resulting in inundation of a major intersection and several industrial complexes.

Summary - Numerous smaller tributaries enter the Taunton at various points along its length. Table C-1 lists pertinent data on all significant tributaries to the Taunton River.

EXISTING DAMS

Along many of the Taunton River tributaries are numerous small dams. All are of the low head type and most were used as impounding structures for industrial or agricultural water supply. Many of these dams no longer serve their original function and all are in various states of disrepair.

TABLE C-1
PERTINENT DATA
TAUNTON RIVER TRIBUTARIES

<u>River</u>	<u>Drainage Area (sq.mi.)</u>		<u>Length (mi)</u>	<u>Slope (ft/mi)</u>
	<u>Gross</u>	<u>Net Effective</u> ⁽³⁾		
Town	60.1	41.1	21.9	8.9
Matfield	78.0	66.9	23.4	1.0
Winnetuxet	38.6	24.7	13.1	10.3
Nemasket ⁽¹⁾	70.0	70.0	23.2	3.7
Mill	42.9	36.4	23.7	9.5
Threemile	85.7	71.9	28.0	7.4
Segreganset	14.5	14.5	9	10.0
Assonet-Cedar Swamp	35.1	20.0	11.0	7.0
Quequechan ⁽²⁾	31.9	31.9	2.2	60

1. Approximately 47 sq. mi. is controlled by the Lakeville Ponds water supply complex.
2. Approximately 12 sq. mi. is above North Watuppa Pond the principal water supply for the city of Fall River, Mass.
3. The Net Effective area is the Gross area less the area controlled by major swamps.

STREAMFLOW

a. Discharge Records - The U.S. Geological Survey is the Federal agency responsible for the collection and dissemination of surface and groundwater data. At the present time, it maintains and publishes records for five stream gaging stations within the Taunton River study area. The location of each station is shown on plate B-1. A summary of streamflow records at all existing stations, plus two discontinued stations, are shown in Table C-2.

b. Runoff - The average annual runoff in the Taunton River basin is approximately 24 inches or slightly over half of the average annual precipitation. About 55 percent of the annual runoff occurs in the months of February, March, April and May. A summary of the mean, maximum and minimum monthly runoff for two selected stations in the Taunton River Basin is shown in Table C-3.

HISTORY OF FLOODS

Flooding in the Taunton Basin can result from either high riverflows or high ocean tides in Narragansett Bay.

a. River Flooding - There have not been many river floods in the Taunton River Basin largely because of its sluggish hydrologic character. High flows can result from moderate rainfall under high antecedent conditions produced by rain storms or snowmelt. Without high antecedent conditions to charge the natural detention areas, large volume rainfall such as that associated with hurricanes is required to produce damaging high flows. One of the earliest known floods in the basin, and probably the greatest, reportedly occurred in February 1886 when up to 9.6 inches of rain fell in the vicinity of Taunton. There are no known records of flood levels or discharges for this event, only reports of extensive damage and buildings washed from their foundations.

The two highest flows recorded on the Taunton River at State Farm occurred in March 1968 and March 1969, respectively. Both were the result of moderate rain under high antecedent conditions. The third greatest flood of record occurred in August 1955 after hurricane rainfall with relatively low antecedent conditions. Other moderately high flows occurred in December 1970, December 1973 and December 1945. These last three events were produced by rainfall amounts ranging from 2 to 4 inches. Rainfall and peak discharge data for historic events are listed in Table C-4.

TABLE C-2

TAUNTON RIVER BASIN
STREAMFLOW DATA

<u>Location of Gaging Station</u>	<u>Drainage Area</u>	<u>Period of Record</u>	<u>Discharge</u>			<u>Date</u>
			<u>Average</u> (cfs)	<u>Minimum</u> (cfs)	<u>Maximum</u> (cfs)	
Dorchester Brook near Brockton	4.67	1962-1974	8.3	0	35.9	3/18/68
Taunton River at State Farm	260	1929-1975	464	8	4,480	3/20/68
Wading River at W. Mansfield	19.2	1953-1975	32.0	0	341	3/19/68
Wading River near Norton	42.4	1925-1975	72.7	0.3	1,460	3/19/68
Threemile River at No. Dighton	83.8	1966-1975	165	5.3	2,490	3/19/77
Segreganset River near Dighton	10.6	1966-1975	21.8	0	86.7	3/18/68

TABLE C-3
MONTHLY RUNOFF
(cfs)

Wading River
near Norton, Mass.
D.A. = 42.4 Square Miles
50 Years of Record

Taunton River*
at State Farm, Mass.
D.A. = 260 Square Miles
45 Years of Record

<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	97	192	15	623	1,196	148
February	104	232	28	650	1,338	210
March	158	354	76	985	1,739	520
April	132	276	41	844	1,586	221
May	82	227	29	559	1,418	237
June	48	182	10	334	987	123
July	26	225	4	205	1,039	66
August	20	175	3	176	1,094	43
September	22	106	2	195	834	52
October	27	143	3	228	937	52
November	59	210	5	406	1,308	75
December	89	257	10	566	1,648	109
Annual	72.0	(23.24 inches)		481	(25.32 inches)	

*Taunton River at State Farm Discontinued 23 April 1976

TABLE C-4

RAINFALL - DISCHARGE DATA
TAUNTON RIVER AT STATE FARM GAGE
(DA = 260 Square Miles)

<u>Date</u>	<u>Discharge</u> (cfs)	<u>Antecedent</u> <u>Condition</u>	<u>2-Day</u> <u>Rainfall</u>
20 March 1968	4980	High	5.90
27 March 1969	4080	High	2.9
21 August 1955	4010	Med-Low	9.72
December 1970	3820	Med-High	1.8
December 1970	3330	High	4.0
8 December 1945	3080	Med-Low	3.40

b. Tidal Flooding - The Taunton River, from its mouth to well upstream of Taunton, is subject to saltwater flooding from abnormal tides in Narragansett Bay associated with hurricanes or severe coastal storms. The two greatest tides of record on the Taunton River occurred during the New England hurricane of September 1938 and hurricane "Carol" in August 1954. During these two events the peak stillwater level on the Taunton River at Fall River was 13.7 and 13.4 feet above msl, respectively. Reports of highwater marks progressing upstream indicated only slight attenuation in the levels. Fortunately the coincident freshwater flow of the Taunton River was quite low during both floods.

The extent and severity of tidal flooding depends primarily on the coincidence of the predicted normal high tide with the peak of the wind-induced tidal surge. Abnormal storm tide development is discussed in detail for the Mount Hope Bay-Fall River Harbor area in the "Hydrology and Hydraulics Appendix of the Narragansett Bay Area Hurricane Survey Report," published by the Corps of Engineers in 1965.

ANALYSIS OF MARCH 1968 FLOOD

a. General - The record flood of March 1968 was the result of an intense rain which fell on the Taunton River Basin between 17-19 March. Five to seven inches of rain fell on ground that was previously saturated by an earlier storm of 12-13 March. Plate C-2 graphically shows the recorded 6-hour rainfall at Bridgewater, Massachusetts for the 17-19 March storm. Flood peaks recorded on the Taunton River at State Farm and on many of its tributaries with relatively long-term records exceeded previously known maximums. The recorded 1968 runoff hydrographs and watershed characteristics of some of the gaged streams were used to develop representative unit graphs and flood hydrographs for the ungaged segments of the watershed. Then, by combining and routing all component hydrographs, the resulting discharge hydrograph for the Taunton River at Taunton was approximated. Contributing to the discharge through the city of Taunton is the drainage area above the State Farm gage, approximately 260 square miles; the Mill River drainage area approximately 43 square miles; and an intervening local drainage area of about 62 square miles.

b. Gaged area - Of the areas contributing to the flood peak at Taunton only the one above the State Farm gage has a recorded hydrograph for the 1968 flood. Its runoff record was used extensively in analyzing the runoff character of the upper watershed. The analysis included develop-

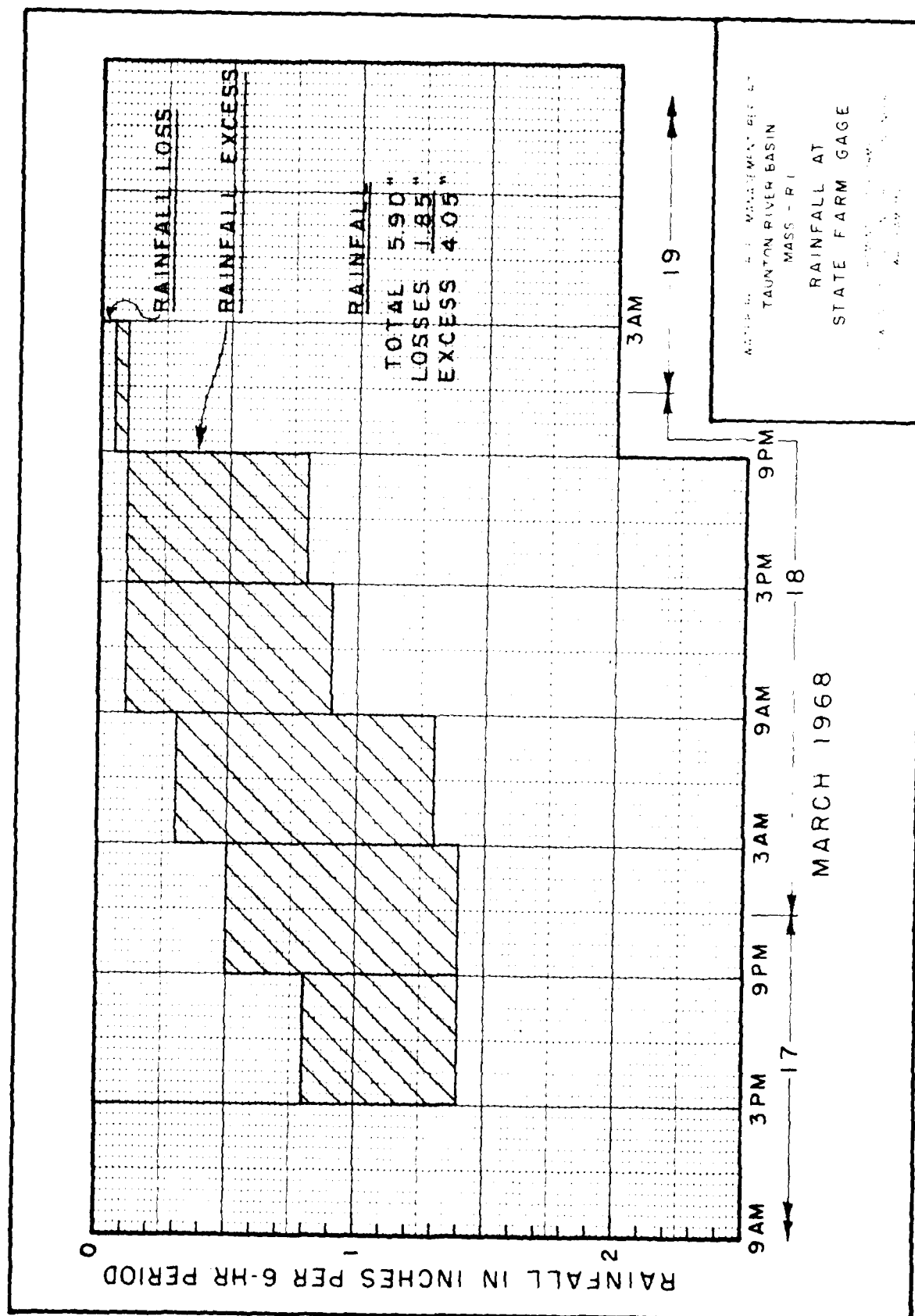


PLATE C-2

ment of a 6-hour unit hydrograph as outlined in EM 1110-2-1407, "Flood Hydrograph Analysis and Computation." In analyzing the area's runoff character, consideration was given to the influence of the extensive wetlands in this part of the basin. These wetlands act as flood detention reservoirs, regulating the peak runoff from their contributing watersheds and their resulting outflow mainly contributes to base flow. Runoff contributing to peak flows comes primarily from the drainage areas uncontrolled by swamps. With this in mind the effective drainage area, total area minus the wetlands, was used in the derivation of the unit hydrograph. The effective drainage area above the State Farm area was estimated at approximately 21 square miles.

c. Un-gaged Areas - Unlike the Taunton River at State Farm, both the Mill River and local drainage area above Taunton have no flow records for the 1968 flood. However, due to their close proximity to and hydrologic similarity with the Threemile River subbasin, a unit graph based on the recorded hydrograph for the 1968 flood on the Threemile at North Dighton was used to develop synthetic unit hydrographs for the Mill River and local drainage areas. In all cases the unit graphs were developed for the effective drainage areas and runoff from the wetland controlled areas was accounted for in the assumed base flows. Rainfall excess for the March 1968 storm was then applied to each unit graph and a computed flood hydrograph, plus base flow which represents the March 1968 flood for each of these areas, was obtained. Table C-2 presents pertinent data for the unit hydrographs. Plate C-3 contains the six hour unit hydrographs for all areas.

d. Flood Development - The computed flood hydrographs for State Farm, Mill River and the intervening local drainage area were routed to the location of the Taunton Sewerage Treatment Plant, the site of the considered hurricane barrier at the downstream end of the city of Taunton. The progressive average-lag method as outlined in EM 110-2-1408 "Routing of Floods through River Channels" was the selected method of routing. Ordinates of all the routed flood hydrographs were then added and a total flood hydrograph, representing the 1968 flood through the city of Taunton, was determined. The routed contributory hydrographs plus the resultant total hydrograph are shown on Plate C-4. The resulting 1968 flood hydrograph at Taunton had a peak flow of 8,400 cfs with a time lag of about 48 hours from the centroid of the excess rainfall.

TABLE C-5

TAUNTON RIVER BASIN
 PRELIMINARY DATA FOR UNIT HY

<u>River/Location:</u>	<u>Flow</u> <u>(cfs)</u>	<u>Flow</u> <u>(cfs)</u>	<u>Flow</u> <u>(cfs)</u>	<u>Length</u> <u>(miles)</u>
Taunton @ State Farm	200	216	23.77	14.94
Three Mile @ N. Dighton	86	72	28.71	16.06
Mill River @ confluence/Taunton	43	36.4	23.72	14.90
Local D.A. @ proposed barrier	62	62	13.26	7.83

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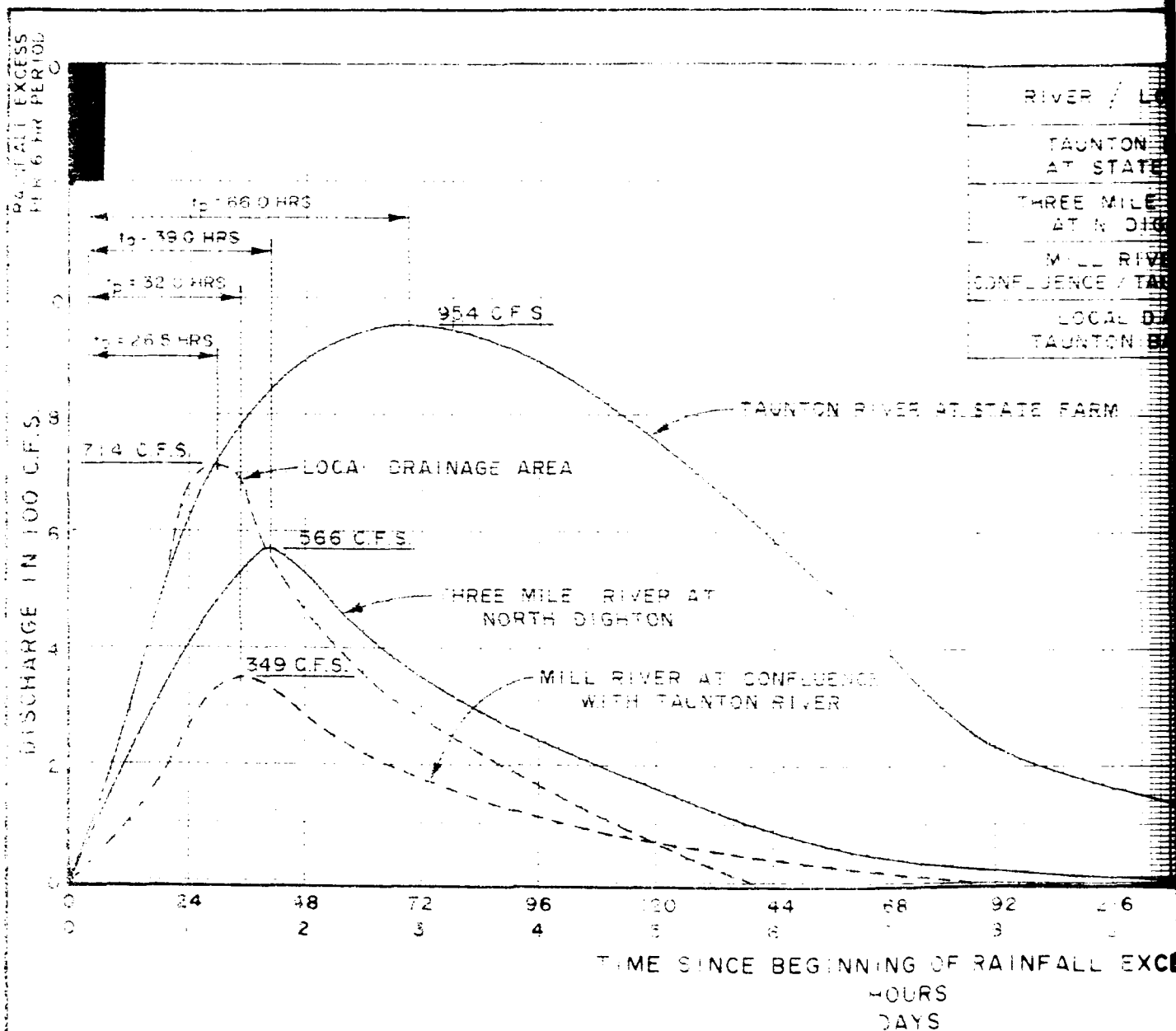
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TABLE C-5

TAUNTON RIVER BASIN

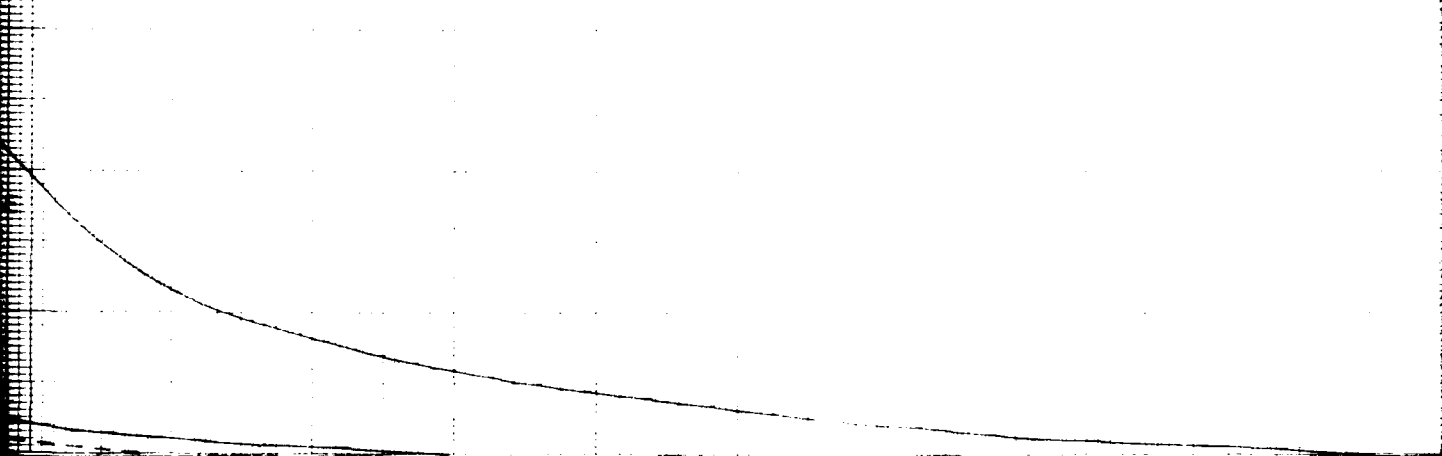
PERTINENT DATA FOR UNIT HYDROGRAPHS

<u>Ive</u> <u>ii)</u>	<u>L</u> <u>(miles)</u>	<u>Lca</u> <u>(miles)</u>	<u>Savg</u> <u>(ft/mi)</u>	<u>Cr</u>	<u>Tp</u> <u>(hrs)</u>	<u>Cp</u> <u>(csm)</u>	<u>Op</u> <u>(cfs)</u>	<u>Cpu40</u>
	23.87	14.04	3.55	11.53	66	4.42	954	992
	28.01	16.06	7.4	6.24	39	7.87	566	307
.4	23.72	14.90	9.5	5.51	32	9.59	349	307
	13.26	7.83	6.83	6.50	26.5	11.58	718	307



RIVER LOCATION	D A Total	(Sq. Mi) Effective	L (Miles)	W Width	S Slope	C Curve	T Time	S Speed	C Capacity	C Capacity
TAUNTON RIVER AT STATE FARM	260	216	23.87	404	3.55	1.63	66	4.42	954	292
THREE MILE RIVER AT N. DIGHTON	86	72	28.01	306	1.4	0.24	39	7.87	586	307
MILL RIVER AT CONFLUENCE - TAUNTON RIVER	43	364	23.72	430	3.5	5.5	32	9.59	348	307
LOCAL D A AT TAUNTON BARRIER	62	62	3.26	183	1.81	1.60	28.5	5.8	1.2	307

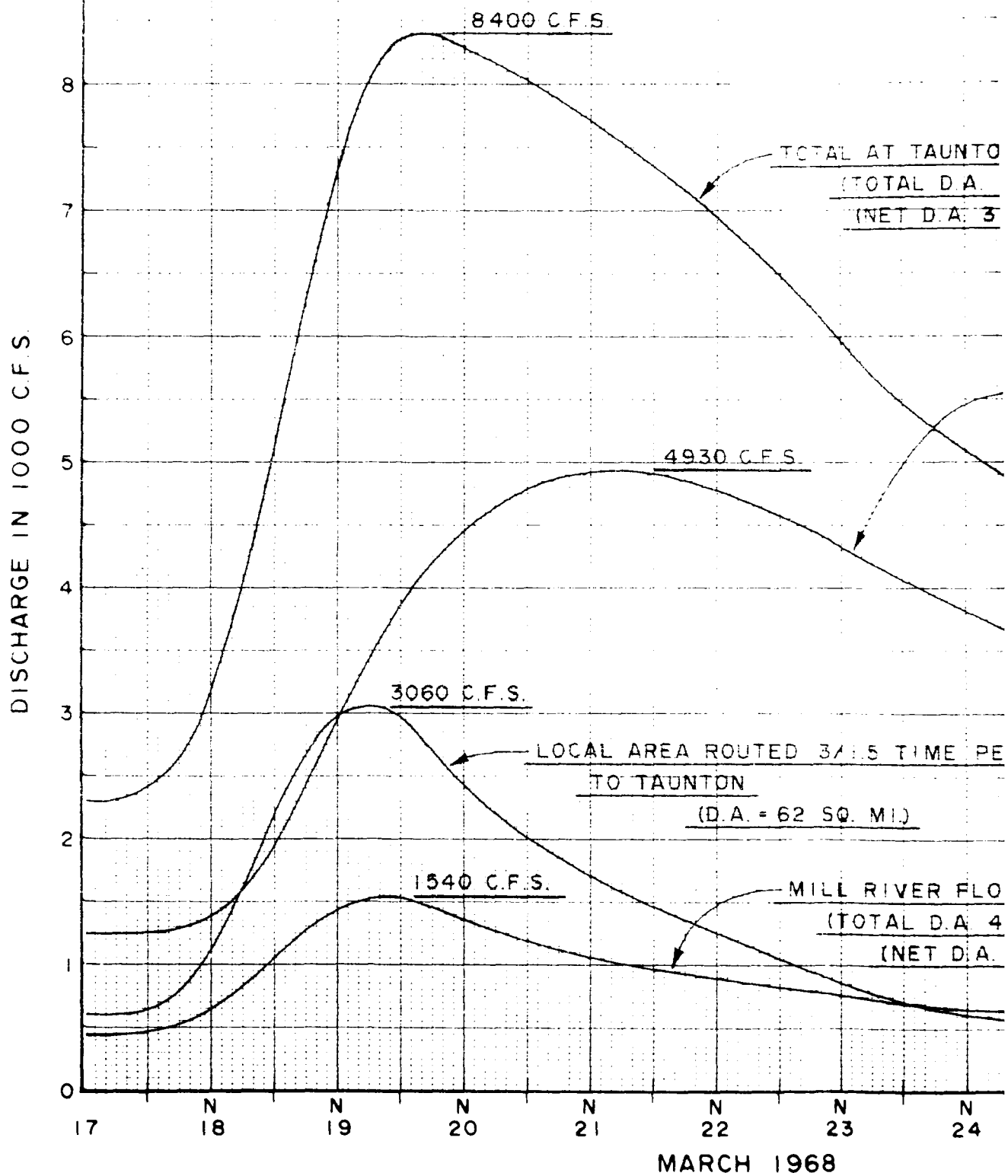
RIVER AT STATE FARM

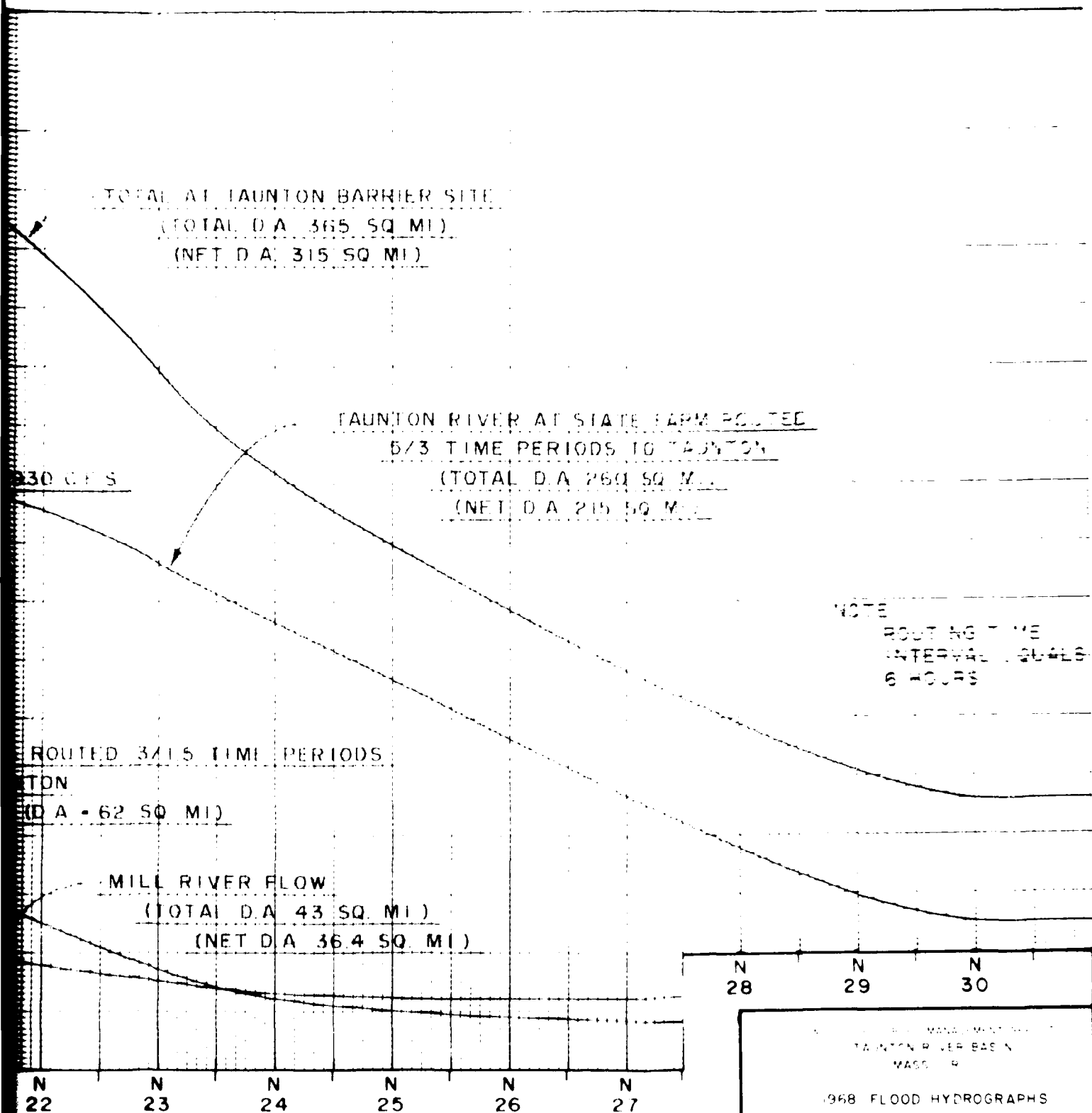


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ING OF RAINFALL EXCESS
HOURS
DAYS

UNITED STATES GOVERNMENT
TAUNTON RIVER BASIN
MASS.
NAT. HYDROGRAPHS
ANALYSIS OF THE
TAUNTON RIVER BASIN





MARCH 1968

1968 FLOOD HYDROGRAPHS

FLOOD FREQUENCIES

a. Peak Flow Frequencies - Peak flow frequencies for the Taunton River were estimated by analyzing all recorded peak flow data at gaging stations. This data was then related to ungaged areas by hydrologic characteristics. The data was analyzed using a Log Pearson Type III statistical distribution as presented in "Statistical Methods in Hydrology" by L. Beard, dated June 1962, more recently described in U.S. Water Resources Council Bulletin 17, "Guidelines for Determining Flood Flow Frequency." The long-term gage record for the Wading River at Norton was used as a base station, and some of the short-term station data was correlated with the long-term data to extend the length of record. Pertinent statistical parameters developed from the analysis are listed in Table C-6. Annual peak flows used in the analysis are listed in Table C-7. Adopted discharge frequency curves are shown on Plate C-5. The discharge frequency for the Taunton River at Taunton, downstream of the State Farm gage, were developed by increasing the State Farm frequencies relative to the increase in the computed March 1968 flood peaks at the same downstream location. A regional skew of 0.70 was used for all discharge frequency analyses.

b. Rainfall Frequencies - Storm rainfall frequencies for the Taunton River Basin, as reported in U.S. Weather Bureau Technical Paper No. 40, are listed in Table C-8.

c. Tidal Frequencies - As stated earlier, flood stages on the lower reach of the Taunton River are greatly influenced by storm and hurricane tides in Narragansett Bay. Based on historical high water information there has been little difference in tidal elevations during past storm events between the mouth of the river and close to Taunton, some 17 miles upstream.

The frequencies of abnormal tides at Fall River at the mouth of the Taunton River were estimated and reported by the Corps of Engineers in the previously referenced hurricane survey report. The flood frequency relationship was approximated using the records of the U.S. Coast and Geodetic Survey tide gages for the previous 33 years and adjusting the records of the great floods of 1938 and 1954 to a 146-year period for which newspaper accounts are available on disastrous tidal floods. Plotting positions for record tides were calculated using the "Hazen" formula. The resulting tidal elevation-frequency curve for the Taunton River at Fall River is shown on Plate C-6.

TABLE C-6

LAUNTON RIVER BASIN
NATURAL PEAK DISCHARGE

<u>Period of Record Actual/Adjusted</u> <u>EXCEEDANCE FREQUENCY</u> <u>Per 100 Yrs.</u>		<u>Launton R.</u> <u>at State Farm</u> <u>(200 S.M.)</u> <u>(40 yrs.)</u>	<u>Launton R.</u> <u>at Taunton</u> <u>(395 S.M.)</u> <u>F</u>	<u>Wading R.*</u> <u>at W. Mansfield</u> <u>(19.2 S.M.)</u> <u>(23/44)</u>
	<u>Years</u>			
0.5	200	6790	11,500	630
1.0	100	5890	9,950	530
2	50	5100	8,620	440
5	20	4200	7,100	340
10	10	3570	6,030	280
20	5	3000	5,070	222
30	3.33	2690	4,550	192
40	2.50	2450	4,150	166
50	2.0	2260	3,820	148
MEAN LOG		3.3687	F	2.1890
STD. DEVIATION		0.1337	F	0.1920

F Discharge Frequency developed by increasing the State Farm Frequency Relative to at this location.

* Short Term Stations, correlated with Wading River near Norton, 51 years of record. Regional skew of 0.70 was adopted for all stations analyzed.

TABLE C-6

TAUNTON RIVER BASIN
TURAL PEAK DISCHARGE DATA

R.# ton M.)	Wading R.* at W. Mansfield (17.2 S.M.) (23/44)	Wading R. Near Norton (42.4 S.M.) (51)	Three Mile R. at N. Dighton (83.8 S.M.) (10/40)	Segreganset R.* Near Dighton (10.6 S.M.) (10/28)
0	630	1850	3250	1100
0	530	1550	2800	950
0	440	1280	2375	805
0	340	1000	1860	640
0	280	810	1550	535
0	222	646	1275	430
0	192	550	1110	382
0	166	495	1000	335
0	148	446	910	302
	2.1890	2.6692	2.9750	2.4980
	0.1920	0.1743	0.1660	0.1720

rm Frequency Relative to the Increase in the computed 1968 flood peak

orton, 51 years of record.

TABLE C-7

RECORDED PEAK DISCHARGES FOR USGS GAGING STATIONS
(c.f.s.)

Water Year	Wading R. near Norton (01109000)	Taunton R. at State Farm (01108000)	Wading R. at W. Mansfield (01108500)	Three Mile R. at N. Dighton (01109060)	Sauganisset at Dighton (01709070)
1926	350	0			
1927	322	0			
1928	270	0			
1929	505	0			
1930	358	1580			
1931	843	2430			
1932	503	1920			
1933	646	2990			
1934	506	2460			
1935	480	3060			
1936	1030	3020			
1937	487	2590			
1938	714	2480			
1939	361	2040			
1940	472	2650			
1941	339	2080			
1942	472	2080			
1943	406	1540			
1944	319	2230			
1945	391	1430			
1946	682	3080			
1947	325	1550			
1948	619	2480			
1950	256	1250			
1951	844	1580			
1952	454	2460			
1953	486	2320	0		
1954	698	3040	188		
1955	1170	4010	519		
1956	616	2860	248		
1957	313	1950	120		
1958	521	2020	180		
1959	380	1760	132		
1960	354	2240	145		
1961	492	2520	167		
1962	467	2940	105		
1963	364	2880	122		
1964	464	2540	102		

1926	350	0			
1927	322	0			
1928	270	0			
1929	505	0			
1930	358	1580			
1931	843	2430			
1932	503	1920			
1933	646	2990			
1934	506	2460			
1935	480	3060			
1936	1030	3020			
1937	487	2590			
1938	714	2480			
1939	361	2040			
1940	472	2650			
1941	339	2080			
1942	472	2080			
1943	406	1540			
1944	319	2230			
1945	391	1430			
1946	682	3080			
1947	325	1550			
1948	619	2480			
1950	256	1250			
1951	844	1580			
1952	454	2460			
1953	486	2320	0		
1954	698	3040	188		
1955	1170	4010	519		
1956	616	2860	248		
1957	313	1950	120		
1958	521	2020	180		
1959	380	1760	132		
1960	354	2240	145		
1961	492	2520	167		
1962	467	2940	105		
1963	364	2880	122		
1964	464	2540	102		
1965	290	1380	91		
1966	254	1450	89	0	0
1967	574	2800	189	1340	513
1968	1460	4980	541	2490	867
1969	819	4080	260	1440	417
1970	779	3820	229	1600	536
1971	363	2240	115	637	282
1972	517	2450	174	1060	269
1973	431	2470	167	955	231
1974	527	3330	162	1090	392

TABLE C-8
STORM RAINFALL FREQUENCIES
TAUNTON RIVER BASIN
(From USWB TP 40)

Frequency (years)	Duration in Hours							
	1	2	3	6	12	24	48	96
2	1.2	1.5	1.8	2.3	2.9	3.3	4.0	4.5
5	1.6	2.1	2.4	2.9	3.5	4.2	5.0	5.8
10	2.0	2.4	2.7	3.4	4.1	4.9	6.0	6.5
25	2.1	2.9	3.1	3.9	4.8	5.6	7.0	8.0
50	2.5	3.1	3.5	4.4	5.3	6.2	8.0	9.0
100	2.8	3.5	3.9	4.9	6.0	7.0	9.0	10.0

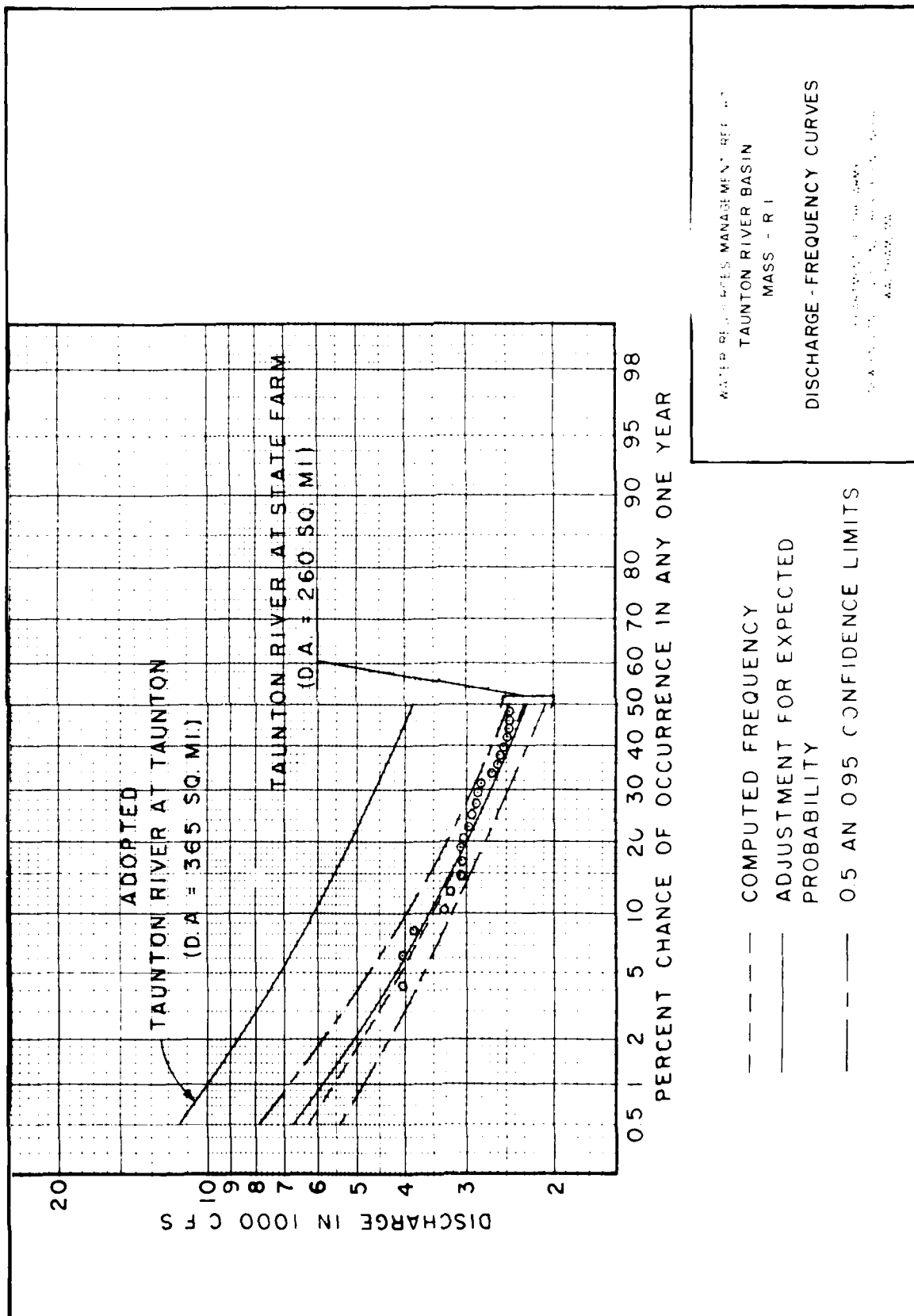


PLATE C-5

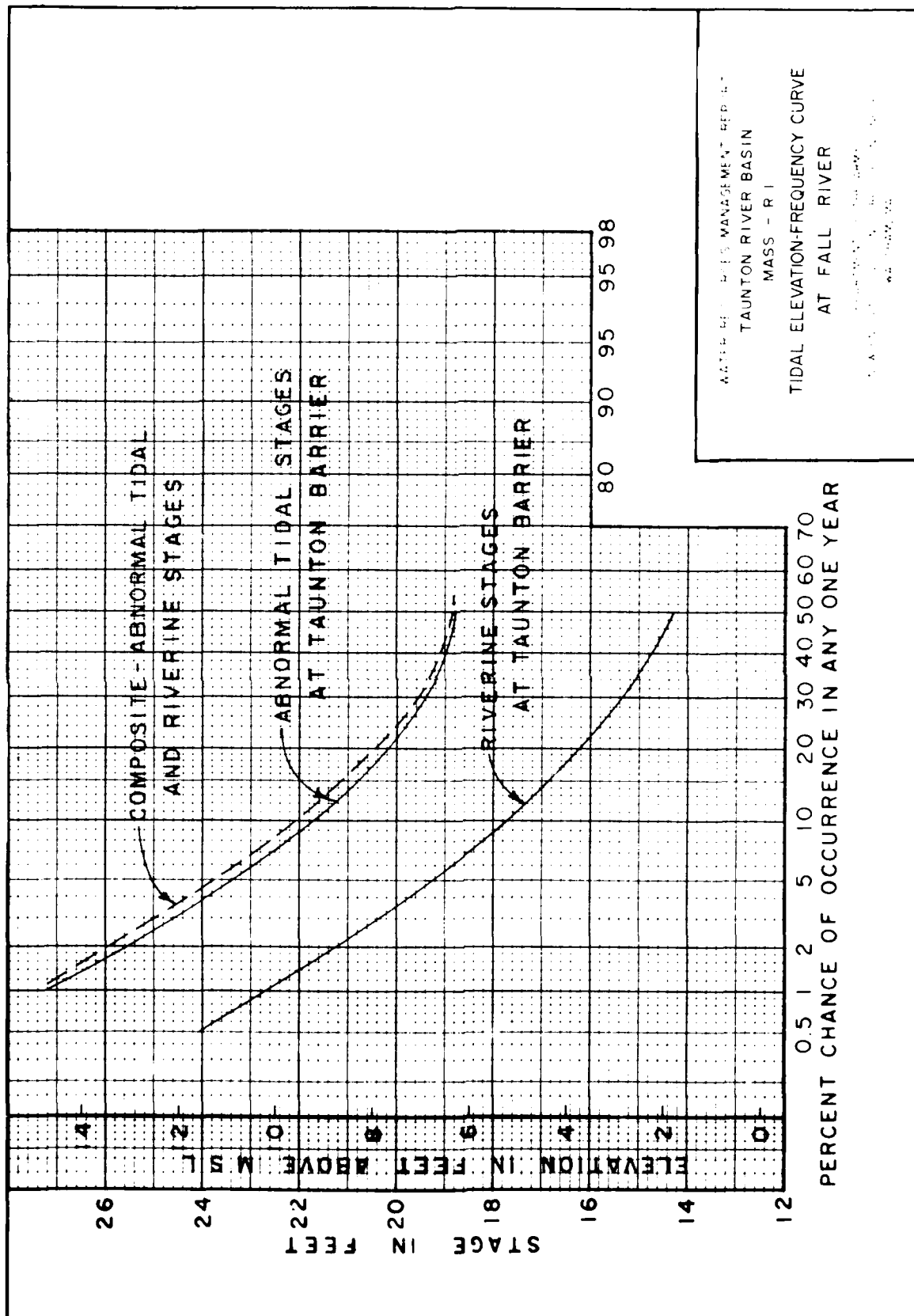


PLATE C-6

d. Flood Stage Frequencies - Flood stage frequency curves were developed at selected index stations using the discharge frequency information just discussed in conjunction with developed stage-discharge rating curves. Rating curves were developed by backwater studies which are discussed below. In the reach of river affected by flood tides, composite stage frequency curves were developed reflecting both tide and freshwater flooding, treating the probability of each as an independent event. For example, if a given flood level is expected to be reached 10 times in 100 years by freshwater flooding and 5 times per 100 years by flood tides, then the composite curve would indicate flooding to this level 15 times per 100 years.

Curves reflecting the freshwater, tidal and the composite flooding frequency at the State Farm gage and at the Taunton sewage treatment plant, a flood damage index station, are shown on Plates C-7 and C-6 respectively.

TAUNTON RIVER FLOOD PROFILES

a. General - Flood profiles of the Taunton River, river mile 0 through 36 are shown on Plate C-8. These profiles denote the September 1938 and August 1954 hurricane tidal flood profiles and miscellaneous high water elevations for the March 1968 riverine flood of record. This information illustrates not only the relative flood levels at various locations in the reach but also the inter-relation in this reach of the river between historic tidal and freshwater flood levels.

Flood profiles were also computed along the river in the vicinity of Taunton as part of the hydraulic analysis for a tidal barrier study.

b. Backwater Analysis - Water surface profiles were computed along the Taunton River in the vicinity of Taunton, using computer program "HEC-2." The model was developed to approximate a natural stage-discharge relationship in the area and facilitate the analysis of various flood control alternatives. The model was calibrated by computing the 1968 water surface profile, using the peak flow values discussed in earlier sections; and comparing this computed profile with the observed 1968 high water elevations. Profiles were computed using computer program "HEC-2" with Manning's "n" values of 0.030 for the channel and 0.040 to 0.080 for overbank areas. Contraction and expansion coefficients were 0.1 and 0.3, respectively. Cross sectional and bridge data for the Taunton River was obtained from the United States Geological Survey's ongoing Flood Insurance Study for the Taunton River at Taunton.

The computed water surface profile for the 1968 flood agreed reasonably well with the experienced high water for that flood. Differences between the two profiles varied by no more than one foot with the average difference being less than one-half foot. In practically all cases the computed profile was slightly higher than the experienced.

Water surface profiles for the experienced 1968 flood are shown on Plate C-8.

ECONOMIC ANALYSIS

Three separate areas within the basin have experienced losses of such a magnitude that damage surveys were required. These are:

- a. The towns of Berkley and Freetown, Dighton, Fall River, Somerset and Swansea;
- b. Salisbury Brook and Salisbury Plain River in Brockton; and
- c. The city of Taunton.

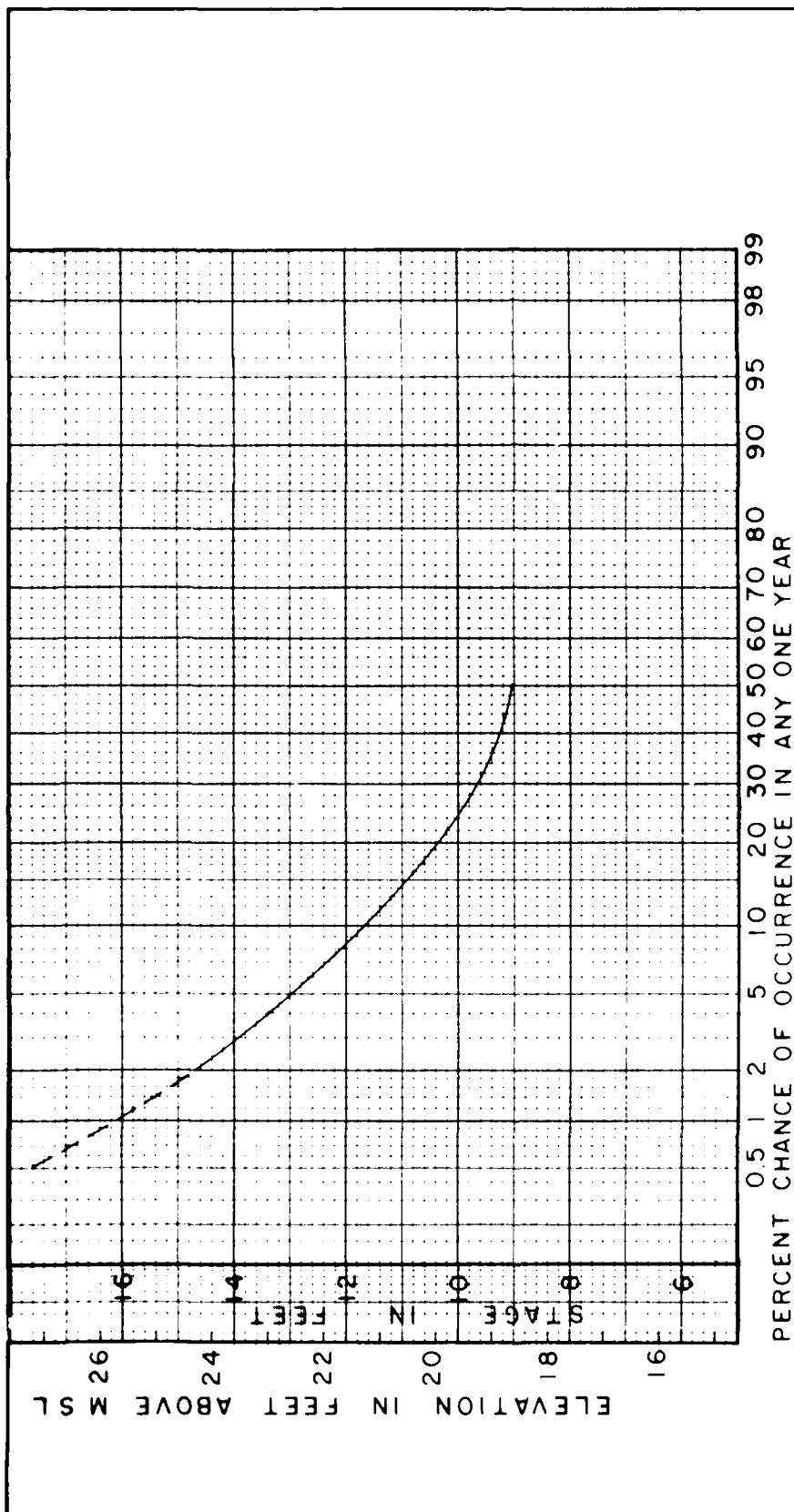
Each of these damage areas was surveyed at a different time and referenced to a different event. The survey in damage area A was performed in 1955 and subsequently updated to 1963 conditions. The reference event for this area was "Hurricane Carol" which occurred in August 1954. Damage area B was surveyed in 1969 and flood damages were referenced to "Hurricane Diane" which impacted the area in August 1955. Damage area C was surveyed in 1977 and the referenced event in this area was the "Great New England Hurricane" of September 1938.

RECURRING DAMAGES

A recurrence of the reference event in each of these areas would result in the following dollar damages:

Damage Zone A

Berkley-Freetown	960,000
Dighton	3,111,000
Fall River	10,292,000



WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R I

TIDAL ELEVATION-FREQUENCY CURVE
AT STATE FARM

COMPUTED BY THE BUREAU OF
HYDROLOGIC ENGINEERING
U.S. ARMY CORPS OF ENGINEERS
WASHINGTON, D.C.



FLOOD PROFILE

Somerset	2,009,800
Swansea	<u>2,132,000</u>
	\$18,504,000
Damage Zone B	\$ 701,000
Damage Zone C	\$ 7,755,000

These figures represent damage which would be experienced in a recurrence of the record event should development remain at survey period levels, expressed in September 1977 dollars.

Table C-9 breaks the recurring damage figure down by the type of structure damaged.

AVERAGE ANNUAL DAMAGES

Average annual damages were calculated by combining stage-damage curves drawn-up by damage analysts with stage-frequency curves. These damages are as follows for each of the damage zones:

Damage Zone "A"	\$ 969,300
Damage Zone "B"	\$ 23,500
Damage Zone "C"	\$ 494,700

FLOOD LOSSES DUE TO GROWTH

A brief survey of this area revealed that although there have been changes in the occupants of the flood-prone areas since the latest update in each damage area; these were not in most cases, substantial in nature. A brief description of these changes follows:

Damage Area A

Berkley-Freetown, Dighton, and Swansea have shown a slight increase in properties susceptible to flooding.

Fall River has experienced no basic growth in properties prone to flooding.

TABLE C-9

Percentage of Total Damage Experienced
by Structure Type

Damage Zone A	<u>Industrial</u>	<u>Commercial</u>	<u>Residential</u>	<u>Public</u>	<u>Utility</u>	<u>Highway</u>	<u>Railroad</u>
Berkley - Freetown	24.0	35.6	34.6	5.8			
Dighton	57.0	12.9	29.6	0.5			
Fall River	71.4	17.5	2.0	7.8	1.3		
Somerset	48.1	9.2	40.0			2.7	
Swansea		18.6	81.4				
Damage Zone B	68.6	9.0	20.1	2.3			
Damage Zone C	54.5	13.8	7.4	4.0	19.2	0.3	0.8

Somerset has experienced a sizeable increase in residential properties in flood-prone areas.

Damage Area B

Sections of Brockton in the flood plain remain basically unchanged since the 1969 damage survey.

Damage Area C

Taunton's flood-prone areas are unchanged since they were surveyed in March of 1977.

FUTURE GROWTH

Significant future growth in the flood plain is not anticipated in any of the three areas since the flood plains are either developed and/or there are significant amounts of land available in other parts of these towns.

OTHER RELATED PROBLEMS AND NEEDS

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

The land area within the Taunton basin is the supply source of nearly 85 mgd, with the largest single yield coming from the Lakeville Pond complex and the remaining yield supplied by other sources.

In most towns within the Taunton River basin, the yield has been adequate to meet present demands and is projected to remain so through 1995; but by 2020 existing sources to meet forecasted needs will be limited. The projections of future demands for public water in the area has been growing at a steady pace and is expected to continue in the future. In addition to the basin area population growth, the per capita consumption is also expected to increase by a total of about 30 gallons per capita per day (gpcd) by 2020. In order to provide for the anticipated needs of 2020 a total of about 25 mgd of new supplies must be developed within and possibly outside the basin.

WATER QUALITY

The present quality of several portions of the Taunton River Basin precludes or impairs the use of the basin's waters for certain potential purposes including recreation, fish and wildlife habitat and public water supply.

The quality of the basin's water varies from Class "A" on some of the larger ponds to Class "C" on the Quequechan River, portions of the Matfield and Salisbury Plain Rivers and lower segments of the Taunton River. Certain areas within the basin have been designated as unsatisfactory (U) for not meeting water quality classifications. This term implies that the present condition of the water does not conform to its designated classification.

One of the primary degradation contributors is the Brockton Treatment Plant. In order to accommodate the needs of the Brockton vicinity, this facility should be updated and expanded.

Rural degradation occurs in the Winnetuxet River watershed and can be attributed to agricultural industry in the area. If left unattended, it will produce serious problems not only for the Winnetuxet River, but the Taunton as well.

The water quality of the Taunton River Basin is, in general, adequate. If additional treatment plants begin operation as planned, it will be feasible for most of the watershed to meet classification "B" status by 1983 as required by Public Law 92-500, the major exceptions, of course, would be the above-mentioned City of Brockton and Winnetuxet River vicinities.

Because of increasing pressures of future population and industrial expansion, abatement of pollution and control of its effects must receive continuing evaluation. The communities of the Taunton River Basin possess a tremendous potential for economic, industrial and social growth. With this in mind, existing facilities will need to be enlarged and new ones planned. Control above basic secondary treatment levels will require consideration.

OUTDOOR RECREATION

Approximately 80 percent of the basin is undeveloped so it currently possesses a variety of natural resources that consists of forest, wet-

lands, fields and open water. Considerable use is being made of these resources at the present time, and by 1990 some shortages will exist. The existing supply of picnic facilities will meet only 20 percent of the 1990 need, existing campsites will meet only 15 percent of the future need, and publicly accessible acreages will satisfy only 50 percent of the 1990 demand.

FISH AND WILDLIFE

Although there are numerous freshwater ponds that are 10 acres or larger (130), only 19 have guaranteed statewide public access. Public access to the 174 miles of streams in the basin is negligible. If all of these waters had adequate public access and were under fisheries management, they could support an estimated 730,000 man days of fishing per year, 80 percent of the 1990 demand. In addition to the demand of the basin's inhabitants, its fish and wildlife resources are utilized by sportsmen from the neighboring Boston metropolitan area.

Another promising fishery resource is the propagation of anadromous species. Unlike most major rivers in New England, the mainstem of the Taunton River is not blocked by dams and thus has excellent anadromous fish potential. Unfortunately, pollution has greatly reduced the shad and alewives that once populated the river. Alewives are still present, but due to the water quality conditions and the dams on some of the tributaries, their population has been held at a level well below the potential of the river system. Shad are virtually nonexistent.

LAND USE

The Taunton Basin is the largest watershed within the PNB study. Despite such cities as Fall River, Brockton and Taunton, a relatively low portion of the area is classified as urbanized, about 18 percent.

The population growth rate between 1960 and 1970 was 17 percent, but this increase consumed 30 percent of the available agricultural land, virtually eliminated the few remaining coastal wetlands and made substantial inroads into the inland wetlands of the area.

The population of the basin is expected to increase by almost 30 percent by 1990 and by 75 percent by 2020. At present rates (acres per capita) about 43,000 acres and 115,000 acres will need to be developed to support the housing requirements of population increases by 1990

and 2020 respectively. Although considerable land is available for growth, it must be guided to developable lands to insure that the critical environmental resources are protected.

LOW FLOW AUGMENTATION

Flows in the Taunton River Basin are affected by both natural and man-caused regulation. Natural flows vary seasonally with high flows generally occurring from March to May and low flows from July through September. High flows are associated with the traditional snowmelt. Man-caused regulation is due to upstream impoundments from cranberry bogs and the numerous mill ponds.

The gravity and extent of this problem is such that at times a major component of the water flow is actually effluent from sewage treatment facilities in the streams and rivers of the basin.

Supplemental low flows could improve stream conditions for many resource needs. They could allow more widespread recreational use of the rivers and streams, improve and stabilize fish and wildlife habitat for all aquatic species, and improve the overall health aspects as well as increase the aesthetic enjoyment. Augmentation of flows would have to come from either new storages that would hold back and retain spring freshets for later release during the summer months or from modification or re-regulation of existing impoundments.

STATUS OF EXISTING PLANS AND IMPROVEMENTS

Other than the two navigation projects, Fall River Harbor and the Taunton River as covered in Section A, there are no Federally oriented water resources projects in the Taunton River Watershed.

LOCAL SUPPORT AND DESIRES

To afford individual citizens and municipal, State and Federal officials an opportunity to present their views and desires concerning the need and extent of improvements and flood reduction measures and other interrelated water-oriented resources, four public hearings, 9, 12, 15 and 22 May 1969, were held at the initiation of the study. Though these four hearings were intended to cover the entire Pawcatuck River

and Narragansett Bay Drainage Basin (PNB) Study area as mandated by seven Congressional Resolutions, the meeting of 9 May 1969 was held in the city of Taunton within the Taunton River Basin.

All interested parties were invited to be present or represented at these hearings, including representatives of Federal, State, county and municipal agencies as well as those of commercial, industrial, civic, highway, railroad, water transportation, flood control and other interests and concerned property owners. They were afforded full opportunity to express their views concerning the character and extent of the improvements desired and the need and advisability of their execution. Sponsors of improvement measures were urged to present pertinent factual material bearing upon the general plans of improvements desired and to give detailed supporting data on the economic justification of the undertaking. Opposing interests were also urged to state the reasons for their position.

Oral statements were heard and for accuracy of the record, all important facts and arguments were submitted in writing, some handed to the hearing officer and others mailed to his office.

All of the attendees at the Taunton Meeting supported and concurred in this study. Excerpts from the record which reflect their general attitude follow:

a. A representative of New England River Basins Commission discussed the then-proposed Southeastern New England Study. The aim of the Commission study was to develop an immediate as well as a long-range action program to secure balanced conservation and development of water and related land resources in southeastern New England. The study was completed in 1976.

b. Congresswoman Margaret M. Heckler, Tenth Congressional District of Massachusetts, recalled the damage created by the flood of March 1968 and discussed the strong stand she has taken on the floor of the House of Representatives to achieve some progress. The Congresswoman expressed a sense of immediacy in addressing the problem with an ".....approach (that) must be a many pronged one because flood control is a multifaceted problem."

Representative Heckler also focused on the long-term needs of a community that plans to attract new industry. She related the water supply potential to hydroelectric power, water pollution, water quality control,

fish and wildlife, navigation, drainage and preservation of aesthetic and historic sites in addition to the immediate flood control problem.

c. A representative of the Massachusetts Division of Water Resources pledged the support and cooperation of that agency.

d. The Department of the Interior, Federal Water Pollution Control Administration, now known as the Federal Environmental Protection Agency (EPA) expressed concern over the water quality of the area.

e. A member of the State Legislature representing Taunton described the concerns of the citizens of Taunton. His constituents feel that the situation is so grave that they demand results.

f. Mayor Benjamin A. Friedman of the city of Taunton discussed topographical weaknesses of the area. He cited examples of major floods in history, including those of 1784, 1815, 1886 and 1968, which provide strong evidence for the need for flood protection. He noted that the Hockomock Swamp has been classified as a wetland of national importance for wildlife by the United States Fish and Wildlife Service. The Mayor recommended that Federal action for preservation be taken in the absence of State or local initiative. The Commonwealth has subsequently purchased almost all of the Hockomock Swamp area.

g. Representing the business community, the Executive Vice President of the Taunton Chamber of Commerce expressed great concern that improvements be undertaken at the earliest possible date to relieve the threat of flooding because past measures have been inadequate. Any action should also deal with other water usage, as the business community is concerned about the condition of the water supply.

h. A representative of the Easton Conservation Commission discussed the need for a plan protecting the flood plains, either by zoning laws or public acquisition of these lands.

Numerous other interests pledged support of the study and reiterated the need for progress.

SECTION D

Formulating a Plan

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KEY STEPS IN PLAN FORMULATION

Prior to discussion of the evaluation criteria and the specific procedures used in the study, a summary of the plan formulation procedure is presented at the beginning of this section. The guidelines for plan formulation are contained in the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources", Federal Register, 10 September 1973 and Corps of Engineers Engineering Regulations contained in the 1105-2-200 series. A four-step plan formulation process was employed with each successive step being a more detailed analysis of available measures. A summary of the plan formulation process follows, including a flow chart in Figure D-1.

Step 1 - Identified all possible regulatory and corrective measures that would meet the flood protection needs of the basin. This consisted of a brief analysis of how individual measures acting alone could resolve existing and/or potential future flood problems. Measures were rejected at this stage based upon general knowledge.

A "no action" plan -- one that would exclude Corps of Engineers participation other than as consultants to Federal agencies -- was evaluated throughout the plan formulation process (steps 1 through 4) as an alternative measure in all damage zones. It presumes as a baseline condition that the National Flood Insurance Program would be available throughout the basin.

Step 2 - Consisted of a preliminary screening or qualitative analysis of all plausible measures derived from Step 1, including those that would not entail Corps participation. This analysis involved preliminary study of specific individual measures that appeared to warrant further consideration and elimination of all measures deemed unfeasible, impractical, inadequate or socially unacceptable.

Step 3 - Consisted of a second or intermediate screening to determine those measures that should receive detailed consideration as to whether they warrant inclusion in a flood management system for the basin. Intermediate level quantitative structural and/or economic analysis was performed on all measures reaching this step.

Step 4 - Entailed formulation of the selected plan of improvement for appropriate scale of development.

FORMULATION AND EVALUATION CRITERIA

The selected plan must represent an acceptable and justified solution that best responds to the problems and needs of the area. Technical, economic and social criteria were applied in evaluating all the possible alternatives as well as any potential environmental degradation that could occur because of the projects implementation.

Abbreviated planning methods were used for determining the most viable alternatives. They are explained more fully in the following paragraphs of this section. It should be emphasized that for all alternatives considered supplemental planning criteria involving public acceptability, project completeness, its effectiveness, any possible irreversible effects, and the ease of maintenance and operation were used to refine the number of alternatives to a tolerable number without obviating the problems and needs of the study area.

Socio-economic data used in evaluating the benefits and costs of the various alternatives considered were derived from Corps investigations and basic economic data published by other Federal and State agencies. Hydrologic and hydraulic data were obtained from Corps investigations. Environmental impact information was obtained from Corps studies and from water quality sampling investigations by the Federal Environmental Protection Agency.

ECCNOMIC CRITERIA

General economic criteria applied in the evaluation of alternatives are summarized as follows:

- a. Tangible benefits must exceed project economic costs.
- b. Scope of development should provide maximum net benefits however, intangible considerations, such as risk to lives and property, could result in a project size which is greater than that which would produce maximum net benefits.
- c. There are no more economical means, evaluated on a comparable basis, for accomplishing the same purpose or purposes which would be precluded from development if the recommended plan were undertaken. This limitation refers only to alternative possibilities that would be physically displaced or economically precluded from development if the recommended plan were implemented.

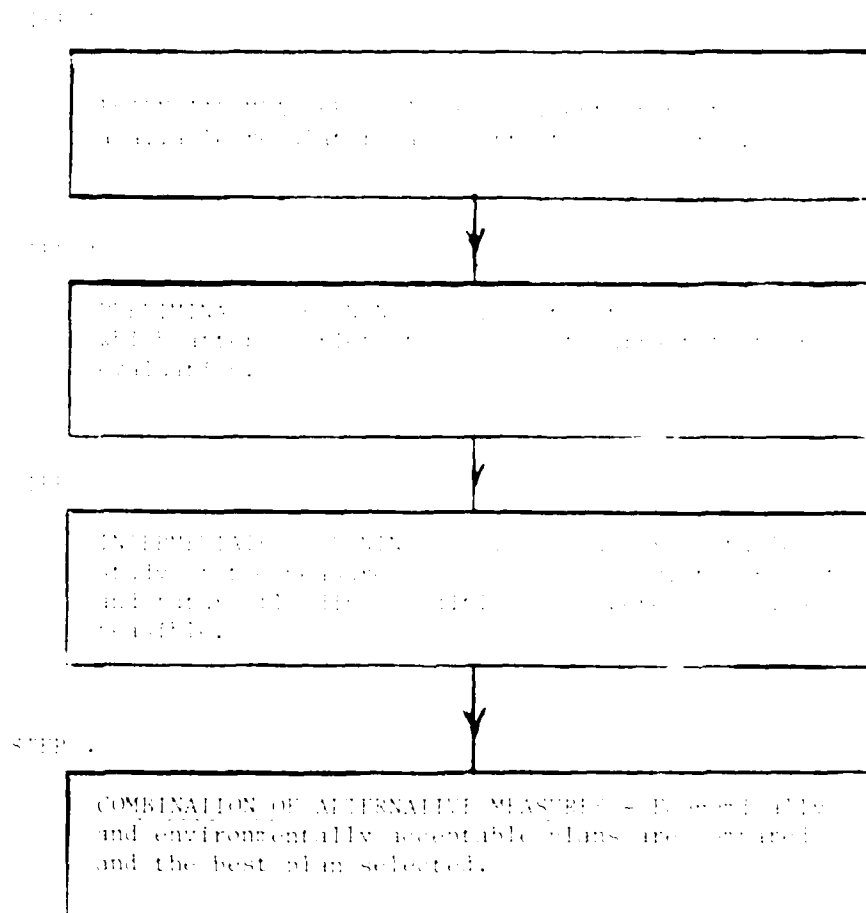


FIGURE D-1

The economic benefits were initially evaluated at 1976 prices and field conditions and projected over a 100-year period of economic analysis. As this analysis progressed, estimates were updated to reflect new price levels, with the final phases of the plan formulation reflecting January 1978 prices. An interest rate of 6 and 5/8 percent was applied during the plan formulation process.

TECHNICAL CRITERIA

Technical criteria were adopted from appropriate engineering regulations, manuals, pamphlets and technical letters, and supplemented by engineering judgement and technical experience. Basically, the plan should be engineeringly feasible to implement, be complete within itself and require no additional future improvements, and insure against significant worsening of any flood conditions. Where practical, the alternative measures considered for urban areas were formulated in accordance with applicable regulations which stipulates that the standard project flood is an appropriate level of protection for high dikes and floodwalls in urban areas. It also states that if the standard project flood protection plan is unjustified or only marginally justified, the level of protection may be reduced to yield a more economically feasible plan by utilizing alternative flood damage reduction measures. However, reductions in the level of protection below the standard project flood are to be avoided whenever possible.

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Environmental and social criteria utilized in considering the Environmental Quality objective, and the Social Well-Being and Regional Development accounts should include the following requirements of the National Environmental Policy Act of 1969 (Public Law 91-190):

- a. Analysis of the environmental impact of any proposed action.
- b. Identification of any adverse environmental effects which could be avoided should the proposal be implemented.
- c. Evaluation of alternatives to the proposed action.
- d. Determination of the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.
- e. Accounting of any irreversible and irretrievable commitments of natural resources and biological systems which would be involved in the proposed action should it be implemented.

In order to attain the environmental objectives as specified in the Principles and Standards, the following factors should also be considered:

- a. Management, protection, enhancement or creation of areas of natural beauty and human enjoyment.
- b. Management, preservation or enhancement of especially valuable or outstanding archeological, historical, biological and geological resources and ecological systems.
- c. Enhancement of quality aspects of water, land and air, while recognizing and planning for the need to harmonize conservation of the resources with the land use objectives of productivity for economic use and development.
- d. Development and use objectives which minimize or preclude the possibility of undesirable and irreversible changes in the natural environment.

As mandated by Section 122 of the Rivers and Harbor Act of 1970, adverse economic, social and environmental effects of proposed projects should also receive full consideration and will include the following:

- a. *Effects of air quality, noise levels and water pollution.*
- b. Destruction or disruption of manmade and natural resources, aesthetic values, community cohesion, and the availability of public facilities and services.
- c. Adverse employment effects and tax and property value losses.
- d. Injurious displacement of people and businesses.
- e. Disruption of desirable community and regional growth.
- f. Public acceptance of proposed improvements and ability and willingness to meet local cooperation requirements.

Social well-being factors are other desirable elements that should be included in the study and should include the following:

- a. Possible loss of life and hazards to health and safety of the people with and without project conditions.
- b. Preservation of pleasing aesthetic values and other desirable environmental effects, such as pleasing landscapes.

These environmental and social factors form the basis for evaluating and formulating alternative measures for the study area. Greater in-depth coverage of these considerations is included in the Environmental Impact Statement.

POTENTIAL MEASURES (STEP 1)

In formulating alternative measures an array of regulatory and corrective measures as well as a No-Action program were considered. These were compared against the base condition using the criteria of economic efficiency, environmental enhancement and social well-being and were evaluated as acting either independently or supplementing one another. These measures are listed in Table D-1. Subsequent paragraphs briefly describe each measure and the rationale used during the screening processes. Detailed descriptions are provided in this section for those measures which passed preliminary screening and were further evaluated.

NO ACTION PROGRAM

Significant development has occurred in the past several decades within the floodplains. Additional limited floodplain land will be built on until the existing Federal, State and local regulations are fully enforced. The No Action Program assumes that in the absence of any corrective Federal Program, local interests would elect to participate in the National Flood Insurance Program (NFIP) and enforce its requirements to control the future growth within the floodplains.

By declining to participate in the NFIP, communities become ineligible for any Federal funds to be expended within a flood prone development. As ownerships of existing properties in the floodplain are transferred, new homeowners desiring financing from any Federally insured lending institution must obtain flood insurance. By law, if this necessary insurance coverage cannot be obtained, a mortgage could not be underwritten.

The No Action Program is a measure that already has been adopted by some of the basin communities. As soon as the remaining towns enter the regular program of the NFIP, the No Action Plan will be completed. This program, at a minimum, would allow the floodplain property owner or a tenant the opportunity to purchase subsidized insurance coverage to help protect against any economic losses that could occur as a result of a major flood event.

TABLE D-1
POTENTIAL MEASURES

NO ACTION PROGRAM
(See Text for Definition)

REGULATORY MEASURES

1. National Flood Insurance Program
2. Flood Plain Regulations
 - a. Encroachment Lines
 - b. Zoning
 - c. Subdivision Regulations
3. Land Use Programs
4. Other Regulatory Measures
 - a. Building Codes
 - b. Urban Redevelopment
 - c. Tax Adjustments
 - d. Warning Signs
 - e. Health and Fire Regulations
 - f. Cleanup Campaign
 - g. Flood Forecasting

CORRECTIVE MEASURES

1. Land Treatment Measures
2. Reservoirs
3. Walls and Dikes
4. Reservoir Management Programs
5. Hurricane Barriers
6. Stream Improvements
 - a. Channel Modification
 - b. Modification or Removal of Dams
 - c. Diversion of Flood Flows
7. Floodproofing or Relocation

REGULATORY MEASURES

By themselves regulatory measures do not reduce, eliminate or prevent the threat of flooding. They regulate or discourage the use and development of the floodplains, lessening the threat of flood damage and possible loss of life. Several regulatory measures which are nonstructurally oriented and applicable to this watershed are described in the following paragraphs.

National Flood Insurance Program - This program was established under the Housing and Urban Development Act of 1968, expanded in the Flood Disaster Protection Act of 1973 and subsequently amended. It was specifically designed to provide limited amounts of flood insurance, previously unavailable from private insurers, to property owners by means of a Federal subsidy. In return for this subsidy, the Act requires that State and local governments adopt and enforce land use and control measures that will restrict future development in flood-prone areas in order to avoid or reduce future flood damages. These measures include floodplain zoning, careful siting and drainage preparations, special construction practices and building materials, special treatment of sewage disposal systems, and elevation of the first floor above the level of the 100-year flood. Flood insurance is available through local insurance agents only after a community applies and is declared eligible by the Federal Insurance and Hazard Mitigation Office of the Federal Emergency Management Administration (FEMA).

Flood Plain Regulations - Several decades of floodplain regulatory experience at state and local levels, plus a substantial body of favorable court cases, attest to the important role floodplain regulations can play in preventing future increases in flood problems. Implementation of adequate regulations may prohibit new uses in urban and rural floodway areas that may cause damaging increases in flood heights. They may require that new uses in both urban and rural flood areas be designed with individual flood protection through elevation on fill or structural floodproofing to the 100-year flood elevation.

There are three principal floodplain regulatory tools at the local level that are available for usage. These consist of zoning, subdivision controls and building codes. Each is detailed in the following paragraphs and summarized on Tables D-2 through D-4.

a. Zoning - Zoning is the most popular local floodplain management. Traditional zoning divides a community into districts and applies varying use standards to each of the districts. A zoning ordinance consists of a map which delineates the use districts and a written text which describes use standards for the districts. Use standards are of two types, one that determines the classes of use (commercial, residential, etc.) in

TABLE D-2

OVERVIEW: FLOOD PLAIN

Purposes

1. Protect public safety and prevent nuisances by prohibiting dangerous uses (e.g., chemical factories in flood hazard areas), unreasonable increases in flood heights due to floodway encroachments, and threats to safety by location of quasi-public uses such as motels in flash-flood areas.
2. Promote most suitable and economic use of community lands as a whole by implementing comprehensive land use plans allocating flood plain areas to uses consistent with the flooding threat.
3. Reduce the cost of public facilities and assist in the implementation of facility plans for roads, sewer, water, schools, etc. by preventing or limiting the type and density of development in flood hazard areas.

Regulatory Standards

1. Delineate floodway areas and prohibit new structural uses and land alterations which will individually or cumulatively increase flood heights or velocities beyond defined levels.
2. Establish flood protection elevations and protection standards for floodway and flood fringe areas and uses.
3. In some instances, abate existing floodway uses of a nuisance nature and require flood-proofing with major alteration of flood fringe uses.
4. Divide flood fringe into commercial, residential and industrial flood fringe zones, and other districts with specifications designed to reduce conflicts between uses and promote the general welfare.

TABLE D-2

OVERVIEW: FLOOD PLAIN ZONING

<u>Standards</u>	<u>Advantages</u>	<u>Limitations</u>
<p>te floodway areas and w structural uses and tions which will y or cumulatively in- d heights or velocities ned levels.</p> <p>sh flood protection eleva- protection standards for d flood fringe areas</p> <p>instances, abate oodway uses of a nui- e and require flood- th major alteration of e uses.</p> <p>flood fringe into com- idential and industrial e zones, and other dis- specifications designed onflicts between uses the general welfare.</p>	<p>1. The major tool of comprehensive planning to promote the most suitable use of lands throughout a community.</p> <p>2. Can incorporate wide range of provisions re- lating to flood plain management and other objectives.</p> <p>3. Can separate flood areas into zones de- pending upon flood hazard and apply vary- ing standards to the zones.</p> <p>4. Most useful tool in preserving floodway areas.</p> <p>5. Can be applied (in some areas) to existing uses with a nuisance character.</p>	<p>1. May "take" private property if too restrictive.</p> <p>2. Does not regulate sale or transfer of lands.</p> <p>3. Often weakened by irrational variances and exceptions.</p> <p>4. Is largely prospective in nature (applies only to new uses) and usual- ly unsuccessful when applied to high- value, nonnuisance existing uses.</p> <p>5. Usually does not incorporate detailed building design standards.</p> <p>6. Many states require prior com- prehensive, community-wide planning although this requirement has not been strictly enforced.</p>

TABLE D-3

OVERVIEW: FLOOD PLAIN SUBDIVISION REG

Purposes

1. Prevent victimization and fraud due to sale of flood lands to innocent purchaser.
2. Protect floodway areas from encroachment by roads, buildings, etc.
3. Insure that roads, sewers, water supply, and other subdivision services are located in areas above flood elevations or protected against flooding.
4. Implement master and comprehensive plans including public facility components.
5. Insure that subdivider installs drainage facilities which are consistent with community drainage system standards.

Regulatory Standards

1. Prevent subdivision of land unsuitable for intended purposes.
2. Require that each building site have an area above flood elevation suitable for building purposes, on-site waste disposal (where applicable) and adequate access.
3. Require that flood hazard areas be noted on face of plat, and in some cases, the adoption of deed restrictions to control future uses in flood-prone areas.
4. Require flood protection for sewer, water, and roads installed by subdivider.
5. Require installation of drainage facilities or payment of fees in lieu of installation by subdivider.
6. In some instances, require dedication of flood areas as parks or for other open space purposes by the subdivider.

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TABLE D-3

NEW: FLOOD PLAIN SUBDIVISION REGULATION

<u>Standards</u>	<u>Advantages</u>	<u>Limitations</u>
<p>Division of land into lots for intended purposes.</p> <p>At each building site, provide flood elevation for building purposes, on-site (where applicable) and on-site.</p> <p>At flood hazard areas, require a flood hazard map of plat, and in the adoption of deed, require control future uses in flood hazard areas.</p> <p>Require flood protection for flood roads installed.</p> <p>Require installation of drainage system and payment of fees in lieu of bond by subdivider.</p> <p>Ordinances, require dedication of easements as parks or for other purposes by the</p>	<ol style="list-style-type: none"> 1. In many states, may be made to apply extra-territorially for urbanizing areas. 2. Very flexible in negotiating with developer. 3. In most states, does not require prior comprehensive planning although a street plan is often required. 4. Can be used to require developer to provide flood data on a case-by-case basis. 5. Not as vulnerable to judicial attack as zoning. 	<ol style="list-style-type: none"> 1. Only indirectly controls use of land; must be in combination with zoning. 2. Difficult to protect floodways unless they are identified on maps. 3. Does not apply to structural design or materials for future structures on subdivision land. 4. Applies, in many instances, only to new land sales and divisions. 5. "Loopholes" common in ordinances which permit subdividers to escape enforcement through "strawman" transactions (i.e., multiple divisions through friends, relatives).

REVIEW OF DRAIN BUILDING

Purposes

1. Protect public and private safety from structures which may collapse during flood.
2. Prevent nuisances from floating structures which may jam bridges, litter other lands, and add to the destructive force of flood flows.
3. Protect public facilities.
4. Prevent blighting, reduction in property values, decrease in tax revenues.
5. Protect buildings and contents from flood damage.

Regulatory standards

1. Require elevation of structures and utilities on fill, pilings, or by other means.
2. Alternatively, require structural floodproofing of buildings and utilities through special design and use of waterproof materials.

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TABLE D-4

OVERVIEW: FLOOD PLAIN BUILDING CODES

<u>Standards</u>	<u>Advantages</u>	<u>Limitations</u>
<p>levation of structures n fill, piling, or</p> <p>ly, require struc- fing of buildings rough special of waterproof</p>	<ol style="list-style-type: none"> 1. Applies to new struc- tures. 2. Often sustained in court. 3. Can be adopted by reference in most states. 4. Simple adoption pro- cedures. 	<ol style="list-style-type: none"> 1. Applies only to new uses. 2. Performance standard approaches require expertise in administration 3. Do not usually apply extra- territorially. 4. Must be used in combination with other tools to preserve floodway. 5. Often not properly enforced. 6. Detailed flood elevation data essential for operation of regula- tions. Flood velocities, flood duration, wave action, erosion pro- blems and other types of "site specific" data required to design or evaluate proposals for structural flood-proofing.

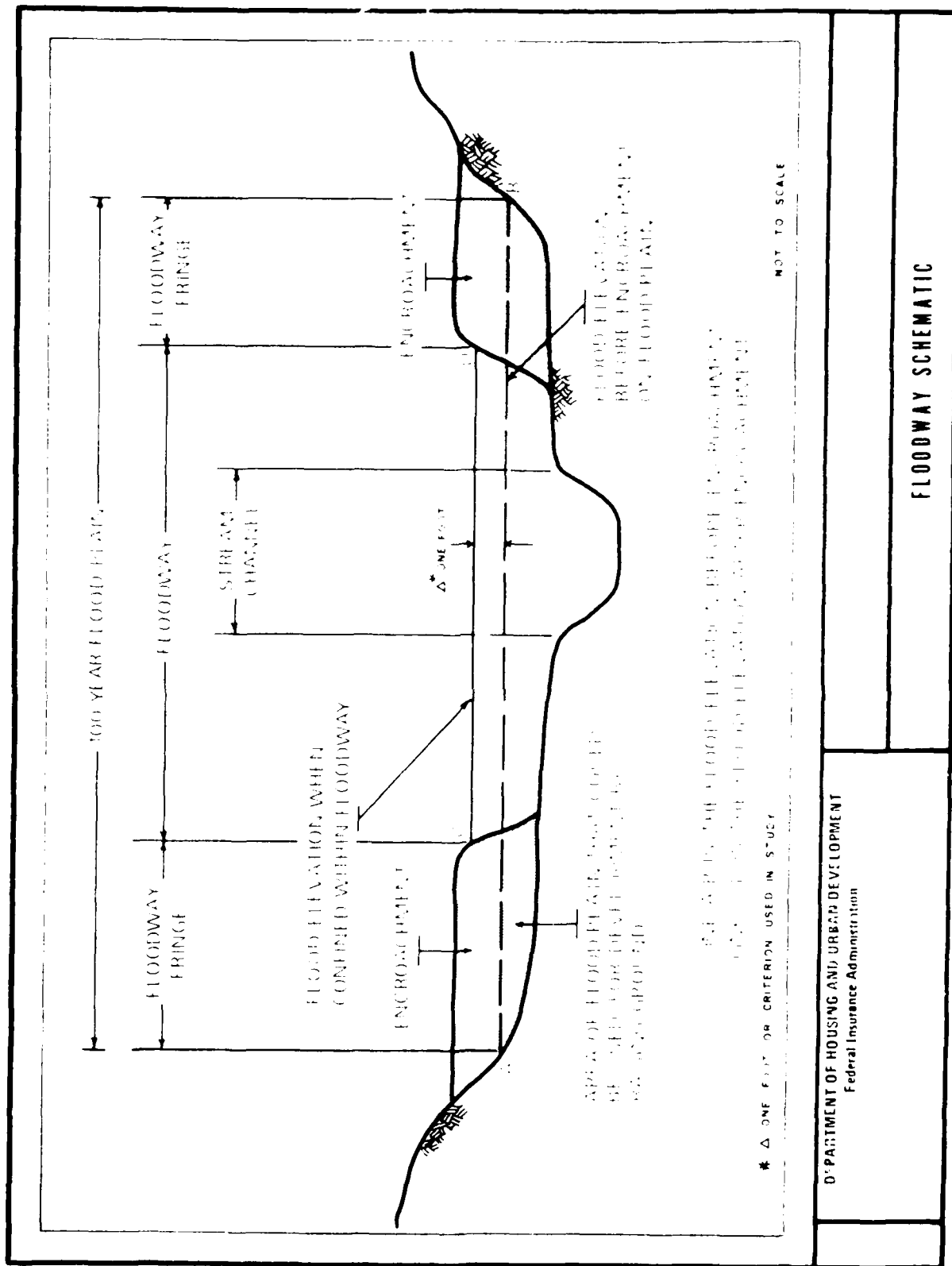


PLATE D-1

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

FLOODWAY SCHEMATIC

the district and the second that establishes minimum standards from permitted uses, such as lot size and building setbacks.

Floodplain zoning maps and the accompanying text are often part of a broader zoning ordinance. One or more floodplain districts are usually delineated on the community zoning map. A single district approach tightly controls all development within the delineated areas. Its use is acceptable for rural towns where considerable vacant land exists in a non-floodplain area. A second approach involves the delineation of two districts; a floodway and flood fringe area. Development is tightly controlled in the floodway to preserve floodflow capacities, but a wide range of uses is generally permitted in the flood fringe as long as each individual structure is protected against flooding losses at the hundred year event. This two district approach permits a wider range of flood plain losses.

The floodway is a portion of the area a selected flood (100 year for the purposes of this report and to coincide with the NFIP definitions) would occupy consisting of a stream channel and overbank areas. The floodway is calculated to be capable of conveying the selected flood discharge without flood heights or velocities increasing to exceed stated levels (1 foot for this report and NFIP). The regulatory floodway is not an actual channel or concrete conduit, rather an area of sufficient width and flood conveyance characteristics to pass the flood waters from upstream to downstream points along a watercourse without increasing the flood heights. In this calculation all areas outside of the floodway are assumed to play no role in passing floodflows, and the floodway itself is assumed to remain in an open condition. Floodway areas are subject to frequent high velocity flooding often at considerable depths. The flood fringe is the portion of the regulatory flood plain beyond the limits of the floodway. It is subject to less frequent and lower velocity flooding and does not play a major role in passing floodflows. See Plate D-1 for a graphical view of each definition.

b. Subdivision Regulations - Subdivision regulations control the division and sale of lands. The regulations require that landowners prepare detailed maps or "plates" prior to the sale of lots. Plates must first be approved by the planning commission. Plates must comply with standards established in the subdivision regulations, zoning and other laws. Subdivision standards relating to flooding typically require that lots be made suitable for intended uses, and that the subdivider install public facilities such as roads, sewers and water with partial or total protection from flooding.

c. Building and Housing Codes - These simply regulate the building design and construction materials. Building areas and a variety of special codes have been adopted by some communities to reduce flood problems or assist in the construction of flood control works. Codes are subject to the same general legal requirements as zoning and subdivision controls. They address limited aspects of flood plains use and a small number of uses and are therefore less susceptible to challenge as a taking of property. However, when exercised in isolation they are also less useful in carrying out overall floodplain management goals.

OTHER REGULATORY MEASURES

Flood Warning Systems - The National Weather Services (NWS) is responsible for forecasting flash floods (those which crest within a period of six hours) and major floods (those which take a longer period to crest). Flood forecasts are generally based upon the amount of precipitation and/or snow melt occurring within a river basin. Flood warning systems utilize sirens, radio, television, and newspapers to disseminate information on floods.

A few communities have adopted flash-flood alarm systems which automatically activate an alarm when flood waters reach a certain level.

Of course, the determination of a flood hazard is only one aspect of a flood warning system. The other aspect - dissemination of information concerning the hazard - is often more difficult. Television and telephones have somewhat simplified the task, but serious communication problems still exist for sudden flood events.

To be optimally useful, flood warnings must allow sufficient time for the evacuation of the people and goods from the floodplains or the initiation of emergency flood protection measures. Flood gates and movable doors for flood proofing may be inoperable due to lack of maintenances or repair, or they may have been misplaced. Cars may not be able to be removed from dealer lots. Material or stock and contents may not be able to be elevated to high ground. It is therefore important that logistic support be provided to make use of advance warnings.

Urban Renewal - Urban renewal has been used in some instances to renovate, raze or rebuild some flood plighted areas and to allocate the lands to open space use to reduce flood losses, provide open space, reduce disease and serve other community objectives.

Tax Incentive - Tax incentive have, in some instances been used to encourage preservation of the floodplain in an open condition to reduce flood losses, provide open space, preserve agricultural land and meet other objectives.

Public Open Space Acquisition - The acquisition of floodplain areas for public open space use has grown rapidly in popularity. Some cities such as Milwaukee have purchased virtually all floodplain areas for park and parkway use. Such acquisitions may serve the final functions of controlling private development and providing public open space for parks, wildlife areas, hiking, water sports and similar use. Public open space recreational uses often may be designed with minimum damage potential from flood waters.

While floodplain lands may be less costly for park acquisition than similar lands throughout a community due to the flooding threats, acquisition costs often exceed several thousand dollars per acre. For this reason, easement rather than fee purchase may be attractive. However, experience with scenic, conservation, and similar types of easements may sometimes be expensive and are unsatisfactory where the public must make intensive use of private land for picnicking or other uses.

Federal grants-in-aid for park acquisition are available from the Land and Water Conservation Fund of the Heritage Conservation and Recreation Service, previously Bureau of Outdoor Recreation. In addition, revenue sharing and state open space funding programs are available, in many states. Generally, the total federal share may not exceed fifty percent of acquisition costs although state grants-in-aid may increase the total state and federal contribution. In some states, park acquisition for floodplain lands is given high priority because of the multiple benefits involved. However, floodplains do not in all instances make good parks because of their topographic features or inaccessability to users.

Proposals have been made to subsidize local floodplain acquisition for open space purposes through state or federal grant-in-aid. Such federal or state subsidies to accomplish multiple goals might in some instances be favored in comparison with flood control works because the multiple benefits (recreation, flood loss reduction) accrue directly to public (rather than private) uses.

Land Treatment Measures - Substantial portions of the upper watershed have undergone a land use change from agriculture to residential or other urban types. As this practice is expected to continue, vegetative and mechanical land treatment measures could be an effective tool in helping to control erosion. In addition to damaging the lands from which the soil originally came, erosion greatly increases the sediment transport rate of the stream resulting in high deposition and increased scour. It is therefore necessary to try to control erosion in these areas. Proper grading of the new subdivisions along with the preservation of as much trees and shrubs are essential. Where possible fast growing annual grass seed should be used, intermixed with slow growing perennial species, to help establish a good groundcover. Maximum slope grading should be established which would slow down any runoff and subsequent scour.

Significant areas of land are still farmed. To help retard the erosion rate conservation land treatment practices should be practiced. Some of these measures are contour farming, cover cropping, terracing, critical area planting, pasture and hayland management and stabilization.

If the above practices are not possible either in the urban or rural areas, alternative measures should be employed to help reduce the erosion. Some of these measures are debris and desilting basins, mulching of steep slope areas, or the establishment of planted buffer zones between open areas.

CORRECTIVE MEASURES

In urbanized flood prone areas, the most cost effective way to reduce existing flood losses is with corrective measures. When considering several flood-prone city blocks of stores and homes, or a large industrial center, it is unrealistic to expect that the regulatory measures will completely solve flood problems.

These corrective measures listed below are the traditional measures that deal with flood problems. Modifications of the natural flood regime are designed to change the extent and timing of floodflow to lower elevations and partially or wholly protect individual structures or entire areas from flooding. Each technique has a somewhat different function and application.

CORRECTIVE STRUCTURAL METHODS

Reservoirs - These are designed to temporarily hold floodwaters and release them slowly to reduce flood peaks. In New England these generally consist of rolled earth and rockfilled structures for impounding uncontrolled floodwaters. They are located at strategic points within a watershed to provide flood protection to downstream communities. An important factor relating to reservoirs that should not be overlooked is their ability to satisfy other needs. Such multiple objectives result in greater utilization of the available natural resources within a watershed.

Walls and Dikes - This approach usually involves a system or a combination of concrete floodwalls, earth-rockfilled dikes, and appurtenant facilities for confining floodflows to the channel or floodway. These are generally referenced as local protection projects because they provide protection to localized, high risk flood-prone areas located behind the dike system.

Reservoir Management Programs - Under certain conditions and barring any legal constraints, restrictions or conflicts, some of the major existing water impoundments within the watershed could be regulated to provide flood control storage. A plan of operation sets the drawdown limits, time and rates so that downstream flood problems are not created and upstream water rights are considered. The object of reservoir regulation is to temporarily retard peak flow long enough to desynchronize tributary flows from the flood peaks on the major rivers, then release those flows at controlled rates as the flood danger passes.

Hurricane Barriers - This measure is utilized where low lying heavily urbanized areas are exposed to either hurricanes or storm induced tidal surges. They consist of a system of dikes and walls along low lying lands that are tied into a rock filled jetty that also usually contains navigational gates and a pump house. When the barrier is placed into operation, the navigational gates (and street gates if any) are closed and braced and the pumps activated. These pumps are used to prevent an increase in the water surface behind the protection caused by any tributary drainage that now cannot flow out normally to the sea.

Stream Improvements - Where substantial flood damages can be attributed to the deterioration or neglect of the waterways, a rehabilitation program for improving channel conditions so as to increase their hydraulic efficiency and subsequent flood carrying capacity could generally be accomplished by the following measures:

- a. To alleviate frequent flooding and subsequent flood losses various methods of channel restoration work could include:
 - Possible elimination of abrupt turns and oxbows;
 - Widening and deepening of certain stretches of river;
 - Improvement of waterway areas at bridges and culverts;
 - Removal of shoals, sandbars, and islands impeding minor flood flows; and
 - Removal of overhanging trees, uprooted trees and accumulated debris at critical points.
- b. Channel improvements of restricted pondage areas by modification or removal of dams could also offer some flood relief to critically high-risk flood-prone areas providing proper measures were taken to prevent excessive scour siltation.
- c. The diversion of floodflows as a means of bypassing heavily congested flood-prone areas could provide an adequate and high degree of flood protection while minimizing the social and environmental impact.

CORRECTIVE NON-STRUCTURAL METHODS

Temporary and Permanent Closures for Openings in Existing Structures - Structures whose exterior is generally impermeable to water can be made to keep floodwater out by installing water tight closures to openings such as doorways and windows. While some seepage will probably always occur, it can be reduced by applying a sealant to the walls and floors and by providing a floor drain where practical. Closures may be temporary or permanent. Temporary closures are installed only during a flood threat and therefore, need warning time for installation.

As most residential structures in this area are made of wood frame construction only the basement would be considered applicable for flood proofing. However, as many industrial and commercial establishments are constructed of concrete block with relatively few openings at zero to three feet above the first floor slab, serious consideration should be given to protecting them, even if at their owners expense. There are however, several disadvantages to this means of protection. As mentioned above it is applicable only to structures with brick or masonry type walls, and only to a level where they can withstand the hydrostatic and uplift pressure of the floodwaters. Another disadvantage is the reduced likelihood of effective closure at nights and during

vacations when temporary closures are employed; and lastly the entire measure may create a false sense of security and induce people to stay in the structure longer than they should.

Raising Existing Structures - Existing structures in flood hazard areas can often be raised in-place to a higher elevation to reduce the susceptibility of the structure to flood damage. Specific actions required to raise a structure include:

- a. Disconnect all plumbing, wiring and utilities which cannot be raised with the structure.
- b. Place steel beams and hydraulic jacks beneath the structure and raise to the desired elevation.
- c. Extend existing foundation walls and piers or construct new foundation.
- d. Lower the structure onto the extended or new foundation.
- e. Adjust walls, steps, ramps, plumbing and utilities and re-grade site as desired.
- f. Reconnect all plumbing, wiring and utilities.
- g. Insulate exposed floors to reduce heat loss and protect plumbing, wiring, utilities and insulation from possible water damage. These actions are intended to place the structure at a higher elevation at its existing site and to protect plumbing and utilities previously below the first floor from water damage. Because the hazard is not eliminated, but only the damage potential reduced, it is important that the potential for flooding below the first floor be recognized in the raising. Lateral stability of the structure should be insured by designing the foundation walls. Such design would include the use of thick concrete mats for the floor slab and a structurally designed concrete wall. Both necessitate the use of reinforcing steel.

Some of the advantages to raising a structure are as follows: Damage to structure and contents is reduced for floods below the raised first floor elevation. It is particularly applicable to single and two story structures already on a raised foundation. There are no elevation limitations to raising a structure as long as the flood waters are allowed to pass through the basement. Finally, the flood insurance premiums for the secondary layer of coverage are drastically reduced.

Some disadvantages are: although most residential damage occurs when floods exceed the first floor elevation, minor damage may occur below first floor depending upon use; measure is not generally feasible for structures with slab foundations or when complete floodproofing of the cellar flooding is essential; excessive landscaping may be necessary if the raising is extensive. Finally that costs are about half the market value of a home, making it extremely expensive for the average homeowner.

Small Walls or Dikes - This measure consists of a wall or dike, generally less than 6 feet high, designed to protect one or several structures and built to be compatible with local environment. Walls may be of any suitable material and designed to resist the lateral and uplift pressures associated with flooding. Dikes are usually constructed with an impervious core to prevent seepage and with a slope protection if erosion is a problem. Where access openings are necessary, provisions must be made to close the openings during floods. Interior drainage facilities such as a small sump pump may be necessary to control the land and roof runoff.

Protecting Damageable Property Within an Existing Structure - Within an existing structure property can often be placed in a less damageable location or protected in-place. Every property owner can do this depending upon the type and location of the property and the severity of the flood hazard. Some possibilities are:

- a. Protecting furnaces, water heaters, air conditioners, washers, dryers, shop equipment and other similar property by raising them off the floor. This may be appropriate for shallow flooding conditions.
- b. Relocating damageable property to higher floors. Moving property from the basement to the first floor or second floor would be an example. This action usually requires altering ducts, plumbing and electrical wiring and making space available at the new location.
- c. Relocating commercial and industrial finished products, merchandise and equipment to a higher floor, or adjacent and higher building, or to a less floodprone site.
- d. Anchoring all property which might be damaged by movement from flood water.

Removal of Structures from the Flood Hazard Areas - The previous description discussed relocating and protecting damageable property within an existing structure. However, at a certain level, this is no longer feasible. This section discusses two options for removing property to a location outside the flood hazard area. One option is to remove both structure and contents to a flood free site. This involves:

- a. Locating and purchasing land at a new site.
- b. Preparing the new site, services, driveway, sidewalk and new foundation.
- c. Raising structure off its existing foundation, transporting it to the new site and placing it on this new foundation.
- d. Moving contents from existing to new location
- e. Removing, disposing and backfilling the foundation at the existing site.
- f. Providing temporary lodging during relocation.

A second option is to remove only the contents to a structure located at a flood-free site and demolish the existing site. This measure includes:

- a. Locating an existing structure, or building a new structure at a flood free site.
- b. Moving contents from an existing to a new location
- c. Either demolishing, and where possible, salvaging the existing structure, or reusing it for a less damage susceptible use.

PRELIMINARY SCREENING (STEP 2)

Table D-5 illustrates the preliminary screening and elimination process used in the second phase of formulating a flood management plan for the Taunton River Basin. The analysis continued with an initial refinement of the actions that were defined in Step 1. The watershed was divided into major tributaries as described in Section B. Each watershed was then subdivided into a main stem and major tributaries if any. Utilizing available data concerning known flood problems and desires of local interests, all potential solutions were evaluated by engineering judgement or brief study for each area. From this process, solutions worthy of further consideration were identified and set aside from measures that did not warrant further evaluation.

At this stage of analysis each measure was evaluated independently from others. Only those measures that provided an adequate, realistic and practical engineering solution and would be socially and environmentally acceptable and economically justified were reserved for more detailed consideration in Step 3. Measures that generated significant adverse environmental impacts were eliminated at this stage of analyses.

	Criterial Affected by River														
	Major Impacts	Land Use Change	Reservoirs	Walls & Dikes	Reservoir Management Program	Hurricane Barriers	Stream Improvement	Dam Modification	Flood Proofing	Relocation	Other	Land Use Change	Reservoirs	Walls & Dikes	Reservoir Management Program
NO ACTION PROGRAM	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
REGULATORY MEASURES	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
CORRECTIVE MEASURES															
LAND TREATMENT MEASURES															
RESERVOIRS	E	1,2	1,2	E	1,2	1,2	1,2	E	1,2	1,2	1,2	E	1,2	1,2	1,2
WALLS & DIKES	E	1	E	1,2		E	E		E	E	E	E	E	E	E
RESERVOIR MANAGEMENT PROGRAM		E	E	1,2	1,2	E	E		E	E	E	E	E	E	E
HURRICANE BARRIERS	E	2		E	E	E									
STREAM IMPROVEMENT	E	1	E	E	E	E	E	E	E	E	E	E	E	E	E
DAM MODIFICATION	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
FLOOD PROOFING	E	1	E	E	E	E	E	E	E	E	E	E	E	E	E
RELOCATION	E	1	E	E	E	E	E	E	E	E	E	E	E	E	E

Criteria Affected by River

1. ECONOMICALLY IMFEASIBLE
2. ENVIRONMENTALLY IMFEASIBLE
3. SOCIALLY UNACCEPTABLE
4. ENVIRONMENTALLY UNACCEPTABLE
5. INADEQUATE PROTECTION
6. NOMINALLY NEEDS OF PROTECTION

NOT AFFECTED

APPENDIX B
COST-BENEFIT ANALYSIS

CLARK COUNTY SUB-BASIN				ADAMS COUNTY SUB-BASIN				SANDY CREEK SUB-BASIN				ECHO CREEK SUB-BASIN				SANDY CREEK SUB-BASIN				SANDY CREEK SUB-BASIN			
Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From	Benefit From
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1,2	1,2	1	1,2	1,2	1	1	1	1,2	1,2	1	1,2	1	1,2	1,2	1	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

CRITERIA APPLIED DURING EVALUATION

1. ECONOMICALLY UNFEASIBLE
2. ENGINEERINGLY IMPRACTICAL
3. SOCIALLY UNACCEPTABLE
4. ENVIRONMENTALLY UNACCEPTABLE
5. INADEQUATE SOLUTION
6. NO MATCH OF NEEDS OR PROBLEM
7. NOT APPLICABLE

8. Further Evaluation Warranted

The No-Action program and regulatory measures were determined to be applicable throughout the basin. Both programs would be geared to preventing or minimizing flood losses to future floodplain development rather than providing reductions in flood stages. For this reason they would supplement possible corrective measures and were reserved for further evaluation.

CORRECTIVE MEASURES

The following corrective measures were analyzed as independent components for solving specific flood control problems and needs pertaining to the basin:

Reservoirs - Within the study area, numerous reservoir sites were investigated to alleviate flooding as well as satisfy other needs. Due to the limited degree of protection that small reservoirs could provide to existing damage areas, the many engineering, social and environmental constraints, and the findings that costs would far exceed accrued benefits, most of the reservoir sites considered were eliminated from further evaluation. Results of this preliminary analysis indicated however, that 10 reservoir sites warranted further investigation, either as single purpose flood control projects or as multi-purpose projects. These are shown on Plate D-2.

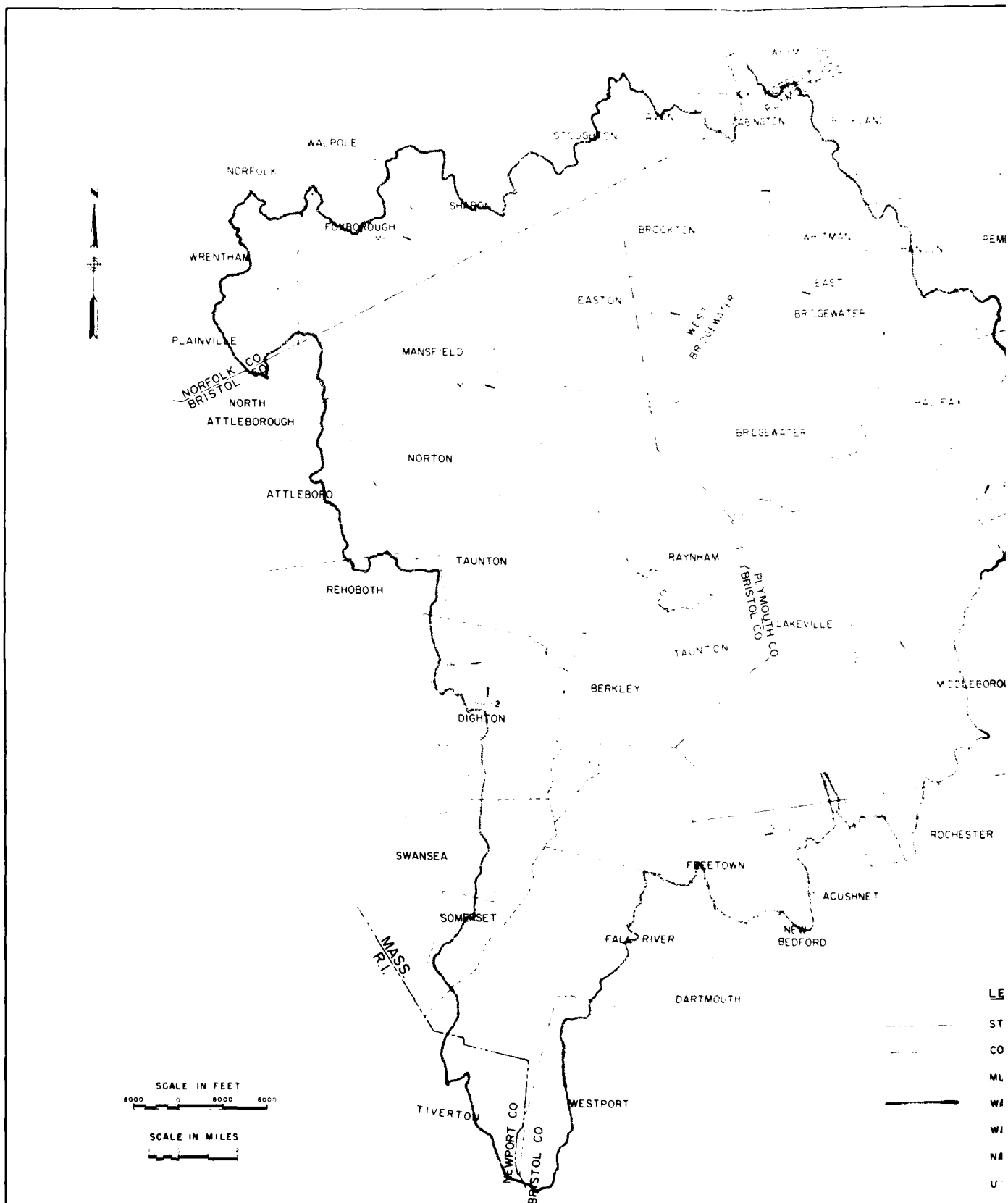
Modifications to existing impoundments or reservoirs were also considered in this stage of analysis. Virtually all large impoundments in the area such as the Assawompsett Pond complex in Lakeville, Lake Sabbatia in Taunton, Lake Winnecunnet and Norton Reservoir in Norton and Watuppa Pond Complex in Fall River have numerous year-round homes and cottages as well as industry surrounding the existing shoreline. Any increase in the height of the controlling structure or replacement with any new dam at either the same location or close proximity would necessitate massive relocations which would greatly increase the costs. Many smaller lakes and ponds are in the basin, but any increase in storage capacity was found to be infeasible. Lake Nippenicket in Bridgewater is the only large lake in the basin that does not have considerable development surrounding it. This lake however, is in the Hockomock Swamp drainage area. Hydrologically, this swamp acting alone provides considerable storage area for flood waters. It has been determined that its upstream drainage area does not contribute any floodflows to the remaining portions of the Taunton Basin. Thus, an increased storage capacity for this lake would provide no additional relief to downstream flood conditions.

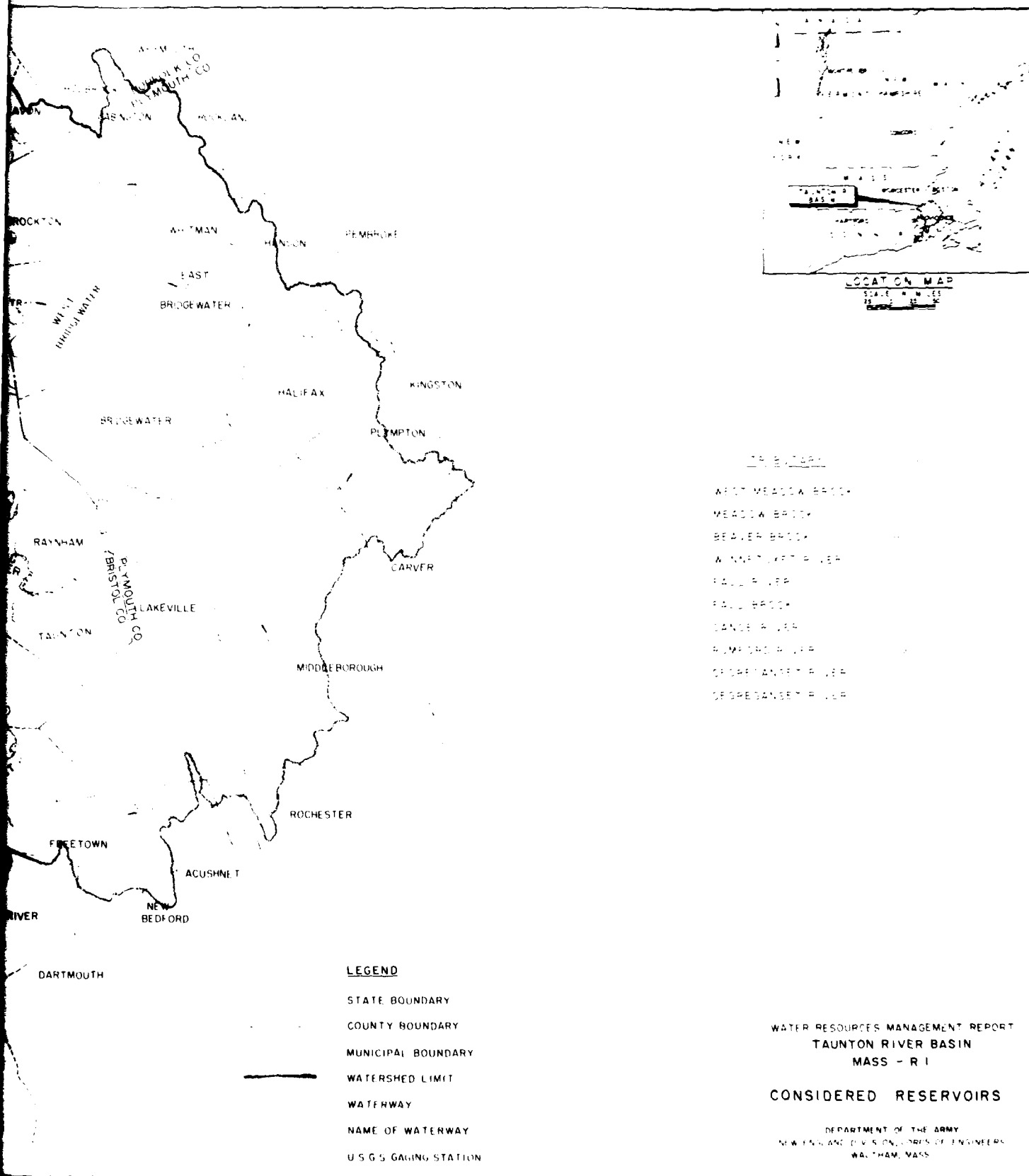
The primary reasons associated with the elimination of many of the reservoir sites along the tributary streams were that they did not control adequately sized drainage areas or their locations were so remote from the damage areas that costs would have been prohibitive.

Walls and Dikes - Concrete walls and earth dikes, generally referred to as local protection projects, are effective means for providing flood protection to high risk flood-prone areas. Potential high damage areas exist along the West Water Street complex bordering the Taunton River in Taunton, the Reed Barton complex along the Mill River in Taunton, the Harodite Company along the Threemile River in Taunton, the Raytheon complex along Threemile River in North Dighton, and the Brockton area bordering most of Salisbury Plain River and Brook. Local protection projects were deemed to be feasible for these areas and were retained for further analyses. The remaining areas have either isolated flood-prone structures or structures that are subjected to only minimal average annual flood losses over a lengthy area. The structures bordering the Mill River, with the exception of Reed Barton and the numerous areas along the Taunton River not previously mentioned, are examples of this.

For the Mill River area extending 1.1 miles downstream from Cohannet Street to the confluence with the Taunton, which includes most of the center of downtown Taunton, the average annual damages are only \$29,400 for both sides of the river. Although allowable economic growth data is not included in this figure, this would allow an expenditure of less than \$400,000 for construction. Assuming protection to a "Standard Project Flood" level, and using a very preliminary engineering study, the construction costs would exceed \$12,500,000, for an annual charge of \$937,500 resulting in an overall Benefit/Cost ratio (BCR) of 0.03. (A BCR of 1.0 or larger is required to warrant expenditure of Federal funds).

The area along the Taunton River downstream from the Route 24 bridge crossing to the confluence with the Mill River has considerably higher average annual damages of \$73,500 that are mostly confined to the northern side along Route 44. However, this stretch is more than 3 miles long and has three significant brooks entering it. Dam Lot Brook, Forge River and an unnamed brook draining a portion of Pine Swamp. To fully protect this commercial area these three brooks would have to be placed in either pressure conduits or lengthy local protective works would be needed to tie into high ground along each small tributary. The annual damages, again exclusive of any growth, would allow for an expenditure of only \$1,000,000 for construction of a project that would provide complete protection.





For both the lower portions of the Mill River and the mainstem of the Taunton River the level of the protective works must be designed for tidal effects. The Standard Project Hurricane level is about 20 feet mean sea level (msl) and the 100-year tide is slightly less than 15' msl. Corps of Engineers design criteria in urban areas call for an absolute minimum level of protection for a local protection project at a 100-year level, but encourage a design approaching a Standard Project Flood. This is based on the remote possibility of the protective works being overtopped by floodwaters which could then cause catastrophic losses to both life and property.

Reservoir Management Program - The basis of a reservoir flood management program is the ability to store and release floodwaters quickly and efficiently. Reservoir storage is used to temporarily detain flood discharges and prevent them from contributing to the peak stage of the flood. To be effective (empty) storage space must be available in the reservoir when the flood occurs. It cannot be used to store water for any other purpose. Because floods often occur in pairs the reservoir must have the ability to be emptied quickly to be ready in case a second flood should occur.

There are very few large impoundments in the study area. With the exception of Lake Sabbatia none has gated outlets capable of quickly lowering the pond level. Usually they are controlled by flashboards or stoplogs limited to a maximum drawdown of only three feet. Also, conversion of the existing storage to flood control purposes would encroach on the present uses (i.e., water supply, recreation). On past occasions the owners of the dam controlling Lake Sabbatia have attempted to provide protection to the property abutting the lake by keeping the water levels low in anticipation of floods. However, some of the storms have not produced as much water as predicted and have left Lake Sabbatia relatively dry, rendering the lake useless for recreation. This situation has been the subject of several town meetings.

Unless flood control storage is included in the design of a dam and the associated upstream impounded area, attempts to control flooding by lowering flashboards and stoplogs, as mentioned above, have met with failure. If a storm does develop, the amount of storage available in the waterbody is minimal. At Lake Sabbatia, the volume of water at normal full pool level is 1,050 acre feet. At maximum drawdown, the volume would be lowered to 1,200 acre-feet or an available flood

water storage of 650 acre-feet. For a Corps flood control dam, a typical design calls for controlling 6" of runoff from the upstream drainage area. For a drainage area of 40 square miles, floodwater storage in excess of 10,000 acre feet is necessary. By contrast at Lake Sabbatia it is evident that full protection would not be obtained, and this storage (650 acre-feet) would provide for less than an inch of runoff. For small storms, such reservoirs do provide a degree of protection, but their value in major storms, such as the March 1968 storm, is negligible. Trained operators at these dams are necessary to allow for passage of certain portions of the flow at specific time intervals to allow for desynchronization of peak flows. This necessitates the use of some form of a reliable gated outlet which is not available. Because of the above reasoning, the reservoir management program was eliminated from further consideration.

Stream Improvements - Channel maintenance of many of the basin tributaries has been neglected resulting in a deterioration of hydraulic efficiency. This deterioration is due to siltation, riverbank or wetlands encroachment, inadequate bridge and culvert openings or general neglect in the removal of excessive vegetative growth and accumulated debris. For example, along the Taunton River parallel to Route 44 numerous trees are ready to slough off into the river, and then float down and clog one or more of the many railroad crossings, as has already occurred. During periods of high riverine flow this accumulation of debris could act as a dam and cause flooding.

Salisbury Brook in Brockton has experienced more severe problems. In addition to the accumulated debris, there are also inadequate culvert and bridge openings and channel encroachment problems to further compound the potential dangers along Salisbury Brook. A prior report on Salisbury Brook analyzed in detail the feasibility of enlarging the channel and associated culvert and bridge openings. The conclusion of the study indicated that the BCR would be well below the level needed to warrant Federal action; therefore, Federal participation in the form of cost sharing would not be possible. Residents of the area could use pumps in their basements and sandbags at low entry points to help reduce flood damages.

Other examples of channel deterioration occur at several locations along the Threemile River. In considering a plan to remedy these inadequacies, the economic benefits do not justify the costs of such an improvement program. While not as expensive as a culvert enlargement, a stream cleanup operation

does not produce appreciable benefits. Channel efficiency would only be improved in very frequent - little damage events during which no benefit is realized. However, it is recommended that local cleanup committees patrol the problem areas.

Floodproofing - As an effective overall solution to the flood problems in the Taunton Basin there are only several areas of high losses that cause a major concern, and these have been mentioned previously. From past experiences in floodproofing studies, it is virtually impossible to recommend floodproofing as a complete solution in a residential area because of high labor and material costs in this part of the country. Individual homes may be economically justified at low frequency events with such measures as placing an impermeable membrane on the outside of the foundation of a structurally sound home, installing a sump pump and blocking up any openings in the cellar. When preventing first floor flooding is the desired level of protection, the entire slab of the structure must be elevated several feet at a minimum. This necessitates new flights of stairs both inside and out and additional plumbing and electrical connections. The resultant house would not look aesthetically pleasing. Costs for performing the services just described would be at least \$10,000 and would require a necessary prevention of \$750 in annual damages to be justified. If water enters the first floor of a reconstructed residence, it becomes necessary to worry about the head of water toppling the basement wall, even if it has been floodproofed, because normal residential foundations are not made of reinforced concrete.

For the residential complexes along the Threemile, Salisbury Plain and Mill Rivers, the height of protection would necessitate installing flood shields for numerous openings such as windows and loading docks. The structural stability of the buildings is also in question as they are very old with cracks in the brickwork. Because these buildings are built along the edge of the rivers, they would also be subject to high velocity floodflows, which further contributes to the flood potential and hazards.

Similar problems would be expected along the banks of the Taunton River, especially in the city of Taunton where floodproofing of over 10 feet would be necessary for protection to a SPH of over 5 feet for 100-year protection. The force of the tide conditions would again be of great concern, especially at Fall River and lower reaches of the river where the full brunt of the hurricane surges would be felt.

Some random floodproofing measures might prove to be economically justified for single structure establishments or residences, but it is not the intent of this study to isolate individual ownerships in an attempt to sell or provide flood protection.

Land Treatment Measures - Investigations by the Soil Conservation Service (SCS) of the erosion problems in the Taunton River Basin indicated that there are serious erosion problems on fewer than 500 acres (0.8 square miles) of land. These problem areas are gravel pits and areas undergoing urban development. The possibility of serious erosion problems exists on those lands which do undergo development for urban use. Much of the erosion damages can be avoided through a sound urban-environmental forestry program to retain as much of the native vegetative cover as possible. Erosion problems on crop land are minor and can be handled sufficiently by the conservation land treatment program. Pasture and forest, except for access roads, have little or no erosion problems at present.

There are no critical erosion problems along the riverbanks though some small isolated areas do exist where shoreline protection will be needed in the future as development increases. Because of the relatively minor erosion problems in the basin, this method of flood control was eliminated from further consideration for the entire basin.

Hurricane Barriers - Under adverse storm conditions, flooding in the Taunton Basin due to tidal influence is almost beyond imagination. This subject was the study of an in-depth report entitled "Hurricane Survey, Narragansett Bay Area - Rhode Island and Massachusetts" that was prepared by the Corps in January 1965. This report and its findings are summarized in Section A.

The only feasible area for location of a hurricane barrier was found to be on the Taunton River in Taunton. Owing to the relatively minor damages along the main stem tributaries, further consideration was terminated for other areas.

Maintenance of Dams - The numerous existing low head dams throughout the basin are in varying stages of disrepair. Many are of timber construction and most were created to divert water from the river for local agricultural or industrial purposes or simply to create a small body of water. The dams are generally "run-of-the-river" types and have practically no regulating storage capability other than incidental surcharge storage; therefore, they have little potential for regulating flood flows. In some instances considerable concern has

been expressed regarding the structural integrity of some of these dams, particularly during high flow periods. Two cases in point are the Whittenden Dam on the Mill River in Taunton and the Arch Street Dam on the Town River in West Bridgewater. At the Whittenden Dam the gates were inoperable and the structural integrity of the dam was gravely taxed during the freshet of March 1968. A partial failure of the Arch Street Dam during the flood of December 1969 resulted in emergency work being undertaken to save the dam. Stabilization of the main portion of the dam and repair of the damaged section probably averted complete failure. Emergency technical assistance was provided by the Corps of Engineers through the former Office of Emergency Preparedness during both of the above events. Though no dam failure has, as yet, created significant flood damages, events such as these have required considerable precautionary measures and have resulted in the disruption of normal business activities in the area for several days. However, practically all dams in the basin are privately owned and are not eligible for Federal expenditures for maintenance or repair except under certain emergency conditions. The State of Massachusetts has the necessary authority under State Law Chapter 253, Section 45 of the Mass. General Laws, as modified by Chapter 21 A, Section 8 to insure proper inspection, maintenance, repair and/or removal of unsafe dams.

Dam Modifications - As a result of the March 1968 storm, flooding occurred around Lake Sabbatia and raised the possibility of the Morey's Bridge Dam and the Whittenton Street Dam failing. A feasibility report on replacing or reconstructing these two dams was prepared in March 1973 by consulting engineering firm of Metcalf and Eddy, Inc., for the Commonwealth of Massachusetts. This report indicated that the outlet structure at Morey's Bridge dam is incapable of discharging high flood flows without raising the level of Lake Sabbatia to a point causing high damages or failure of the dam. The engineers' recommendation called for construction of an additional outlet channel, controlled by two 20-foot wide aluminum slide gates on the west side of the existing channel at Morey's dam, and a 30-foot wide auxiliary spillway at the Whittenton Dam. Estimated cost for this work was \$337,000 in 1973. As the office has not made a detailed review of the report's design considerations or cost aspects, it is not possible for the Corps to approve this report and its findings. An element which this office would question would be the possible failure of the Morey dam. In the event the additional outlet channel could be justified, it would be mandated that the structural stability of the old dam be guaranteed. The A/E report mentioned the possibility of piping, a leaking of water through the bridge abutments, occurring. If our

investigations revealed such a condition, a new dam would be required. Assuming the dam meets applicable Corps of Engineers design and safety standards (we have not officially reviewed the report) the minimum estimated cost is \$500,000 or an average cost of \$37,500 amortized over a 100-year life. The average annual losses for the homes abutting the lake would be less than \$10,000. This would result in a BCR of less than 0.25. This recommendation would only pass the floodflows downstream. The lake does not have sufficient storage volume available to retard the floodflows as mentioned in earlier paragraphs.

Dam modifications were not considered for further evaluation for any of the remaining areas because of the relative absence of high annual losses and the high construction costs associated with renovating or replacing existing dams. Only the Norton Reservoir area has experienced any losses due to an apparently inadequate sized spillway. Since the 1968 storm, a new spillway was constructed to help alleviate the flood threat. To further correct this would entail major reconstruction of the dam. Reiterating, the existing annual losses to the area surrounding the reservoir would not warrant further consideration.

Relocations - This alternative is most likely to be recommended where one or two isolated structures suffer frequent heavy damages, especially to contents. Benefits again must exceed project (relocation) costs as is the rule for all Federal investments. It may also be recommended where floodproofing is no longer practical due to either excessive heights of the desired level of protection or high costs. No areas in the Taunton Basin are justified for relocation because of the relative lack of serious, frequent flooding and the high cost of building acquisition.

Conclusions - The results of Step 2 screening show that only a limited number of corrective solutions warrant further consideration. At this stage of analysis, these measures have been shown to meet only the minimum acceptable plan requirements and are evaluated as only single purpose measures.

As the roles of the No-Action program and all regulatory measures are oriented to fulfilling projected needs and to establishing appropriate measures for preventing or minimizing future flood problems, their importance for further evaluation, particularly as a supplement to

corrective measures, merit consideration. Consequently, both programs are being retained for further analysis in Step 3.

INTERMEDIATE SCREENING (STEP 3)

EVALUATION OF MEASURES

This phase of the plan selection and formulation process involved further refinement of individual measures that passed the preceeding screening. This step continued with a more detailed identification of the measures that could provide an adequate degree of protection in heavy damage areas while satisfying the economic criteria. Each of these measures was evaluated as an individual entity.

The objective of this study is the development of a viable flood management program for relieving present and future flooding conditions. The regulatory (nonstructural) program would be the initial element of the evaluation, followed by the corrective (structural) program where applicable.

REGULATORY PROGRAM

There are considerable tracts of vacant land throughout the basin as well as a projected high growth rate for the basin's towns so the requirements of the regulatory program are valid measures to prevent future flood losses to new development. The programs, which would help control future flooding, would be keyed to protecting the invaluable large swamps mentioned on table B-2.

The flood storage capacities of these and other smaller swamps rival the degree of protection afforded by flood control dams that have been constructed by the Corps. Without these swamps, downstream flood heights would be higher and would increase damages. Fortunately, there is not a major degree of development within the flood plains of most of the basin's tributaries and major rivers. Only the Mill River and the Salisbury Plain Brook and River have significant structural flood plain utilization. Keeping development out of the flood plain would now become the second type of regulating measure employed in the overall basin plan.

Upstream Valley Storage Areas - Basinwide acquisition of the larger swamps within the basin by the Federal Government is not economically justified due to the relative lack of downstream development and the high potential of flooding due to tidal influence. Localized areas of acquisition of swamplands was considered for the Salisbury Plain Brook area and the Mill River Basin. The headwaters of Salisbury Plain Brook are a series of interconnected lakes within the D.W. Field Park complex that is owned by the City of Brockton. This complex does provide a high degree of flood stage reduction to downstream areas. The upstream drainage area at the lower end of the park is small, only 6 square miles. Of this about 3.8 square miles is directly controlled by the reservoir-lake system, and the surcharge storage alone renders this component noncontributing to the flood problems downstream. Swamps comprise a major component of this 3.8 square mile area. As the park is already publicly owned, the storage currently available can be assured in the future. Thus, acquisition of the swamp land is unnecessary although its development should strongly be discouraged by the local conservation commission. The remaining 2.2 square mile area is highly developed land that once was swamps and/or lowlands. The storm water runoff from this component is routed through only the last, and smallest lake in the system. The lake does not have provisions for storage of floodflows. Thus, this area is the major source of the downstream area's problems.

Flood stages along the lower reaches of the Mill River have already been modified by upstream conditions. About 28 percent of the Hockomock Swamp lies within the Mill River drainage basin, accounting for a noncontributing area of about 6.5 square miles of the total 42.9 square mile watershed. The entire Hockomock Swamp has recently been purchased by the Commonwealth and it will be preserved in its present state of wilderness. Numerous smaller swamps exist along the Canoe River, the largest having a surface area of about 700 acres --- it is actually composed of many small interconnected swamps. Insignificant swamps are found in the Mulberry Meadow Brook area with one exception --- a large cranberry bog and reservoir system that simulates a swamp and is in a good location with an upstream drainage area of about 11 square miles.

The Canoe and Mulberry Meadow Brook both flow into Winnecunnet Pond, as shown on Plate B-1. This pond has a natural outlet where the Snake River begins. The entire Snake River is actually the downstream outlet of the Mill River portion of the Hockomock Swamp. No one particular natural storage feature mentioned above is responsible for the degree of flood reduction that the Mill River is already afforded. All systems appear to act in unison with each

other, absorbing some of the runoff and streamflow that passes through the previous swamp or lowland. When the reduced floodflows enter Winnecunnet Pond, they are further reduced by surcharge storage available in the fairly large lake. Hydrologically, it is unrealistic to itemize dollar savings downstream in the damage areas. Assuming the largest swamp system were purchased for about \$500 per acre, it would cost \$350,000 to obtain. This would necessitate annual benefits of \$26,250 to warrant project justification. The present annual damages in the entire Mill River area are less than \$40,000 annually. For that swamp to be obtained by the Federal Government the losses incurred by the filling in of that swamp would have to reach a minimum of \$66,250 annually. This is greater than a 50 percent increase in damages.

Downstream Regulatory Measures - As Federal acquisition of swamps is not economically justified, local conservation commission groups and planning boards are encouraged to enact strict flood plain zoning in these areas. Little pressure is being exerted for use of these swamp lands at the present time because more suitable tracts of land are still available. Some limited filling of the wetlands has occurred in recent years in the Winnetuxet Basin. The filled land will be used for agriculture and grazing land. As downstream losses to structures are virtually nonexistent, increases in damages would not be expected. If filling continues in more developed subbasins, the losses would become more significant.

The minimum acceptable future recommendation should be adherence to the National Flood Insurance Program. This will help to minimize losses due to growth within the basin and, if insured, will enable the homeowner, small businessman, or tenant to recoup most of his physical losses from a flood event.

CORRECTIVE MEASURES

Reservoirs - Reservoirs were evaluated for all areas within the Taunton River Basin by the U.S. Department of Agriculture, Soil Conservation Service, Economic Research Service and Forest Service in cooperation with the Massachusetts Water Resources Commission in a report published in January 1974. The sites were located using the current USGS quadrangle sheets. For each favorable site, field reconnaissances were made that included an inventory of land and man-made structures that would be affected if a dam and reservoir were

developed at the site. When extensive manmade structures would be inundated by the impoundment, the site was dropped in the preliminary screening, Step 2. Preliminary costs for the sites were based on construction costs and land values as of 1972 and include all contingencies, engineering and design costs, and supervision and applicable administrative overheads. They are shown on Plate D-2 and Table D-6. For a reservoir to be considered effective under existing planning criteria, a storage capacity of about 6" of runoff from the upstream drainage area must be available. As a rule of thumb, this is equivalent to the runoff from an event having about a 1 percent chance of occurrence in any given year. This is commonly called the 100-year event by nontechnical people. Many of the reservoir sites evolving from Step 2 control small drainage areas and, other than areas within Brockton and a few small headwater villages, the damage areas are a considerable distance downstream from many of the reservoir sites. Thus, the actual flood reduction capabilities of the reservoirs at the damage areas become marginal owing to the additional increment of the drainage areas. The damages for the areas, determined from windshield surveys, were categorized as negligible (less than \$1,000 average annual damages), slight (between \$10,000 and \$100,000 average annual damages) or heavy (greater than \$100,000 average annual damages). They were classified according to past experience and knowledge. Rough damages were estimated for an approximate 100-year flood, a 500-year flood and the March 1968 event. Average annual damages were then calculated. If damages were not significant at the hundred-year flood level, further analysis was halted. For areas having moderate to heavy damages, detailed field damage surveys were made. Such damage surveys were made of areas within Brockton along Salisbury Plain Brook and River, and in Taunton, Raynham and Berkley along both banks of the Taunton River extending from the Route 24 highway bridge crossing downstream to the Taunton Sewage Treatment Plant downstream to and including Mount Hope Bay. Prior studies of tidal flood areas extending from Dighton to Fall River were made in conjunction with the Hurricane Survey of 1966 for all of Narragansett Bay.

Walls and Dikes - Five areas evolved from the previous step that required more in-depth evaluation for potential use as a corrective measure. The first is the West Water Street complex that borders the Taunton River and runs from the Taunton Sewage Treatment Plant upstream to the near County Street Bridge Crossing, a total distance of approximately 5,000 feet.

TABLE D-6

RESERVOIRS
EFFICIENT DATA

<u>Tributary</u>	<u>Code</u>	<u>Drainage Area</u>	<u>Acre-feet Storage</u>	<u>Estimated Storage</u>	<u>Cost</u>
West Meadow Brook	TR-1	4.98	1650	1250	2,029,500
Meadow Brook	MR-1	5.76	1843	1520	2,801,400
Beaver Brook	MR-2	4.80	1575	800	1,512,000
Winnetuxet River	WR-1	9.91	3180	1400	4,452,000
Fall River	NR-1	6.74	2150	1400	3,010,000
Fall Brook	NR-2	9.21	2940	930	2,734,000
Canoe River	MIR-1	14.29	4350	965	4,198,000
Rumford River	TMR-1	4.09	1300	1175	1,528,000
Segreganset River	SR-1	6.03	1950	2600	5,070,000
Segreganset River	SR-2	8.44	2600	1500	3,900,000

TABLE D-6

RESERVOIRS
PERTINENT DATA

<u>\$/AF @ 0" Storage</u>	<u>Cost \$</u>	<u>Annual Cost \$</u>	<u>Annual Benefits \$</u>	<u>B/C Ratio</u>
1230	2,029,500	152,000	5,000	.03
1520	2,801,400	210,000	5,000	.02
960	1,512,000	113,400	5,000	.04
1400	4,452,000	333,900	1,000	.00
1400	3,010,000	225,800	10,000	.04
930	2,734,000	205,000	1,000	.01
965	4,198,000	314,800	20,000	.06
1175	1,528,000	114,600	5,000	.04
2600	5,070,000	380,300	1,000	.00
1500	3,900,000	292,500	2,000	.01

Significant damage areas exist as one continues to travel upstream along Ingell Street bordering the Taunton River. There is not, however, a suitable high ground location to provide closure to the wall and dike system. Industries that would receive protection from this scheme are a leather tannery, several large-scale plating operations, a chemical products firm and about 10 smaller firms. The Bay State Gas Company and the Taunton Municipal Light Company would also be protected. Under current conditions, the Light Company would suffer extensive damages at an event having a recurrence interval of 2 percent or less. Water would enter the plant and cause an almost immediate shutdown in operations, leaving some 75,000 customers without electricity. Depending upon the severity of the storm, these customers could be without electricity for a considerable period of time as the downstream generating plants at Brayton Point and Somerset would also be severely affected and would cause extensive shutdowns. Further downstream in Narragansett Bay where tidal surges pass before reaching the Taunton River, similar plants could also be knocked off line. Thus it would not be a simple maneuver to open new electrical service lines from other sources as has sometimes been the case.

Construction of the proposed walls and dikes as shown on plate D-3 would be most difficult. The F. B. Rogers Silversmiths' building forms the right bank of the river, and its walls are not considered to be sound enough to be used as the floodwall. Thus, a new wall would have to be constructed in the river adjacent to the silversmiths. This would necessitate placing steel sheet piling along some 1,500 feet of river and dewatering the area behind it so that the wall and its footings could be constructed. Other buildings are also located near the river's edge, necessitating the use of either concrete walls to minimize the bottom's width of protection or the relocation of the firm to higher ground so that earth dikes could be constructed. Concrete walls generally cost from three to five times per linear foot the cost of a comparable height earth dike system.

A locally known brook located between the Threemile and Mill Rivers, shown on Plate D-3 and which enters the Taunton River through a culvert system in the Municipal Lighting Co. parking lot, is another problem. It has an upstream drainage area of about 3 square miles and would require very large pumps to prevent backwater flooding. If the walls were constructed it could also become necessary to excavate the opposite bank to compensate for the loss in channel area. The necessary level of protection is somewhere between the 100-year level (the minimum considered level) and the Standard Project Hurricane. These elevations are about 15 feet msl and 20 feet msl respectively. Freeboard

CORPS OF ENGINEERS

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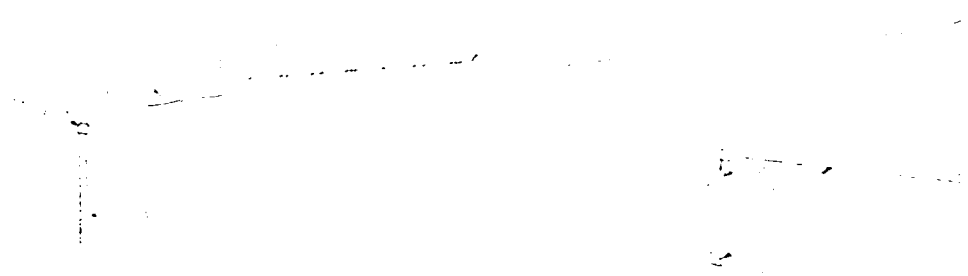
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ASSESSMENT OF THE FLOOD PROBLEMS OF THE TAUNTON RIVER
BASIN MASSACHUSETTS(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV DEC 78

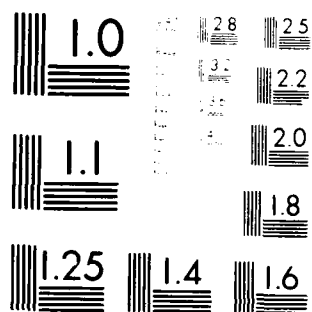
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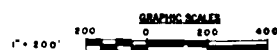
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WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R.I.

**TAUNTON LOCAL
PROTECTION PROJECT**

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS

PLATE D-3

design must also be included -- a minimum of 3 additional feet to add protection against overtopping from wave action and an unforeseeable event occurring, i. e. upstream dam failure or rapid uncontrolled urbanization.

Estimates were made for two levels of protection, the reoccurrence of the July 1938 hurricane which reached an elevation of about 14 feet NGVD, and the SPH. The costs for these two levels of protection are \$11,700,000 and \$14,800,000 respectively; annual costs are \$880,000 and \$1,110,000. They do not include any relocations, land acquisitions or operation and maintenance costs. As the annual benefits attributable to each level of protection are only \$136,000 and \$316,000, the costs exceeded the benefits. Because the costs for the two schemes are fairly close, any intermediate level of protection could still not be justified. Thus, this proposal could not be considered further.

The Reed-Barton complex borders the Mill River in the city of Taunton. It is located about 1.4 miles downstream of the Morey's bridge dam at Lake Sabbatia and about 2.5 miles above the confluence of the Mill River with the Taunton River. It is a large industrial concern housed in many interconnected structures, several of which border the actual channel. The channel is only about 40 feet wide, but it is formed between concrete walls. It has a slope of 22 feet per mile in the reach from the upstream dam to a tailwater pond just downstream. A portion of the Mill flows in a tailrace between several buildings. It has no apparent usage at the present time. There are also three bridge crossings. The firm did not suffer significant losses in 1968, but it was in an evacuated status due to the potential failure of the two upstream dams (Whittenton and Morey) for several days. There are several high water marks in the area of the plant but none of the past floods have caused heavy losses. In fact, heavy losses would not begin until the 100-year event were exceeded.

Two estimates were made, one roughly equivalent to the 100-year event and the other for the Standard Project Flood about two feet higher. The costs were \$1,330,000 and \$1,680,000, respectively, exclusive of lands, relocations, rights of way, and operation and maintenance. The annual charges of \$100,000 and \$126,000 respectively were significantly higher than the average annual damages that this firm would suffer. This scheme also was dropped from further analysis.

The Harodite Company on the Threemile River also could suffer heavy losses from a major flood. It too is in the city of Taunton, located 1.2 miles upstream from the confluence of the Threemile with the Taunton.

This firm suffered losses in the 1968 flood, but again these were of the nuisance type rather than first floor floodings. Fortunately, the main floor is well above ground elevation so only very high floodwater can get into this level. Most of the main building is within 10 feet of the edge of the river, necessitating concrete walls rather than earth dike construction.

The elevations used in the estimates were 2 feet above the floodwater height of the 1968 storm and another 4 feet above the first estimate. These costs were \$730,000 and \$1,350,000 respectively exclusive of lands, damages, rights of way, and operation and maintenance costs. This amounts to \$55,000 and \$102,000 annually, respectively; again far more than estimated annual damages to this structure.

The term annual damages is a somewhat misleading description. It takes into account all the potential damages that the firm(s) could suffer over an extremely wide range of probable annual events, ranging from a storm with a probability of infinity down to an event with an almost yearly occurrence. It is possible for a firm to suffer \$5 million damages from a storm with a recurrence interval of .5 percent (a 200-year storm) and have average annual damages of only \$39,500. If this same firm were to have only a million dollar loss at the 200-year storm, it would suffer only \$9,000 annual losses. The annual loss of \$39,500 is enough to warrant a Federal expenditure of about \$500,000. If the cost of protection were \$600,000 and the annual damages only the \$39,500 mentioned above, the project would not be economically justified even though the damages at a 200-year event were almost 10 times the construction cost of the walls and dikes. It is extremely difficult for the general public to understand the distinction between annual damages and damages incurred by a single event. A firm could suffer what appears to be an extremely heavy financial loss, but it would not be enough to warrant Federal expenditure. This applies to the Harodite Company.

The Raytheon complex also lies along the banks of the Threemile River in North Dighton, about one mile upstream of the Harodite Finishing Company. It suffered minor damages in 1968, mainly from backwater flooding caused by the apparent failure to close a pipe valve. During a severe flood, the complex would have floodwaters well above the first floor of most of the interconnected buildings. At the time of the last field trip to that area (12 April 1977), very few cars were in the parking lots, indicating a high percentage of unoccupied space. Raytheon no longer operates the entire complex.

Costs were derived at two feet above the 1968 and four feet higher than the first estimate. The costs for these estimates were \$1,170,000 and \$1,490,000 respectively. This is equivalent to annual costs of \$80,000 and \$102,000 respectively, exclusive of lands, damage, etc. Once again this is well above what the annual damages would be, resulting in a benefit/cost ratio much lower than the necessary 1.0 to 1.0. The wall and dike systems considered in the above analysis are shown on Plate D-4.

Hurricane Barrier - This proposal would consist of a concrete and earth structure built across the river with large gates to pass freshwater flood flows under normal tide conditions and a large pumping station capable of discharging freshwater flows against abnormal storm tides. It would be located at a point just downstream of the Taunton Municipal Wastewater Treatment Facility, tying into high ground on both sides of the river. Total length of the closure would be approximately 500 feet. It is shown on Plate D-5. Pertinent design features of the structure adopted for initial costing purposes were as follows:

Design stillwater flood level	18.4 feet msl
Allowance for waves and free-board	4.6 feet msl
Design height of structures	22.0 feet msl
Pump capacity (approximate flood of record)	8,000 cfs
Gate sill elevation	-9 feet msl
Number of gate bays	3
Gate bay width *	40 feet

Operation of a tidal barrier across the river to prevent tidal flooding would require the pumping of coincident riverine flows. Pumping riverine flows could result in a drawdown of the water surface for a distance upstream of the barrier, thereby providing further flood control benefits. The beneficial extent of any deliberate significant decrease in water surface elevations was appraised by comparing the flood profiles for natural

*

Gates sized to pass flows in the realm of 16,000 cfs with minimum head-loss during normal tides.

conditions with the profiles for various drawdowns at the barrier. The 1968 flood of record and the 100-year frequency discharges were used in these comparisons. A stage-frequency curve at the site of the hurricane barrier is shown on plate C-6. Drawdowns in water elevations at the barrier of 2, 4, 5, 8 and 10 feet were considered. As an upstream index point the Conrail railroad bridge at river mile 16 was chosen because of its location at the upstream end of the industrial area in Taunton. Table D-7 summarizes the results and Plate D-6 illustrates the natural and modified water surface elevations for the 1968 freshwater flood of record.

A major source of the benefits is derived from preventing tidal surges from entering the heavy industrial and commercial areas upstream of the barrier. The protection afforded is shown on two plates; 100-year tide Plate D-7 and SPH tide Plate D-8. The annual damage for each of these storm events is \$204,000 and \$500,000 respectively. This figure does not take into account any allowable growth in the flood plain or intensification of existing activities.

Costs were developed for the SPH level. This cost is \$22,600,000 with an annual cost of \$1,690,000. The B/C ratio under this condition is 0.3. Thus the project is not feasible for Federal investment.

SUMMARY

As a result of the more in-depth analysis it is apparent that Federal structural measures in the Taunton River Basin are not economical. Regulatory measures such as flood plain zoning and preservation of swamps by non-Federal interests are recommended, as they are not economically feasible for enactment by the Corps. Cities and towns within the Taunton River Basin are urged to comply with the National Flood Insurance Program.

COMBINATION OF ALTERNATIVE MEASURES - STEP 4

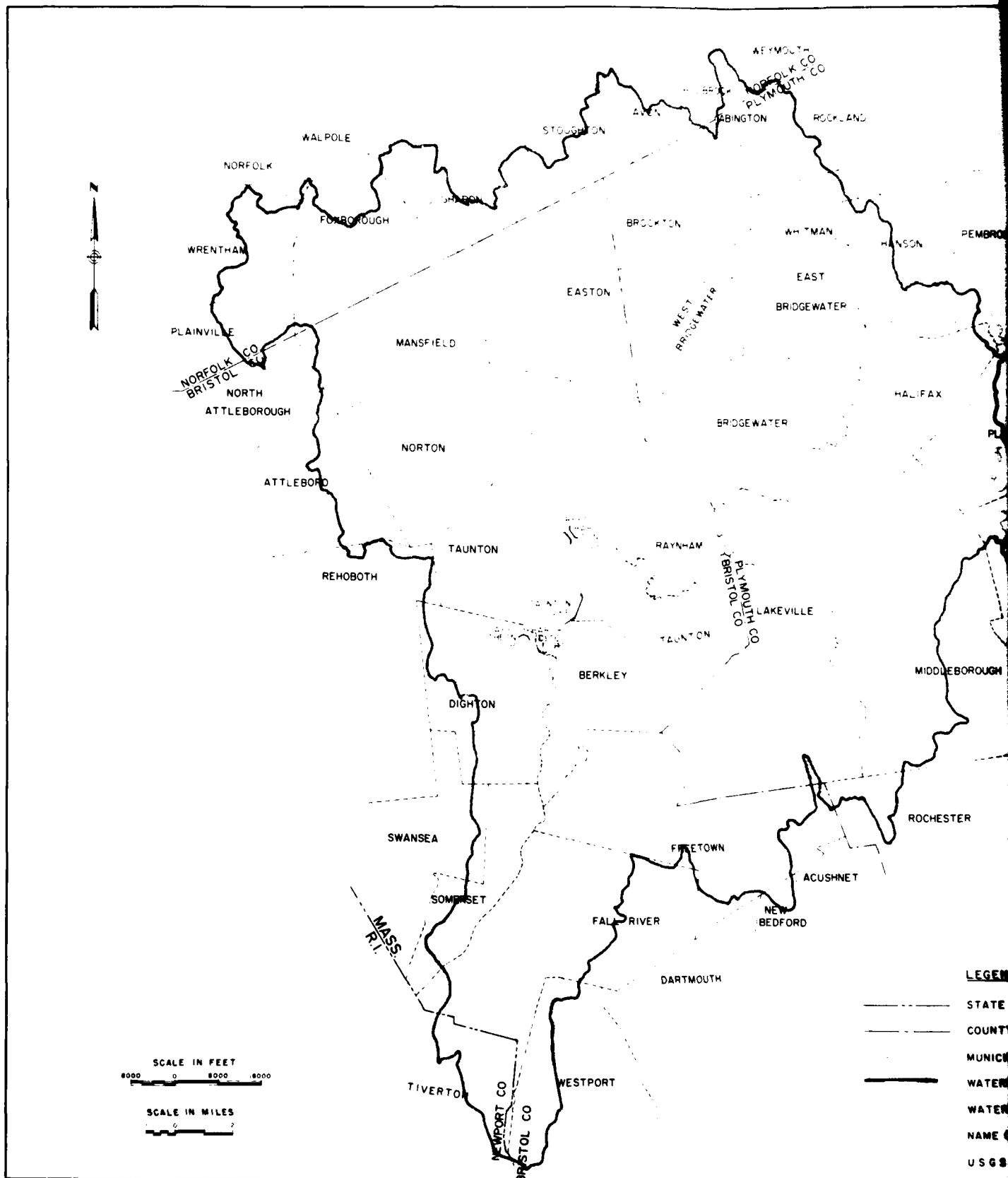
As there are no justifiable structural measures anywhere within the Taunton Watershed, the inclusion of any nonstructural or regulatory program would not have any overall effect on lowering the existing Benefit/Cost ratio for the anticipated selected plan. This is because regulatory measures help control future growth both in and out of the flood plain but do nothing about existing development. Thus, the selected plan for the Taunton Watershed must consist of the regulatory measures only.

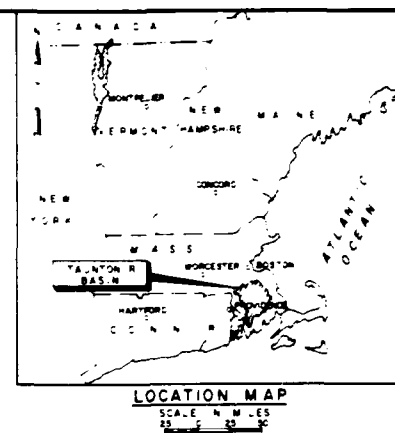
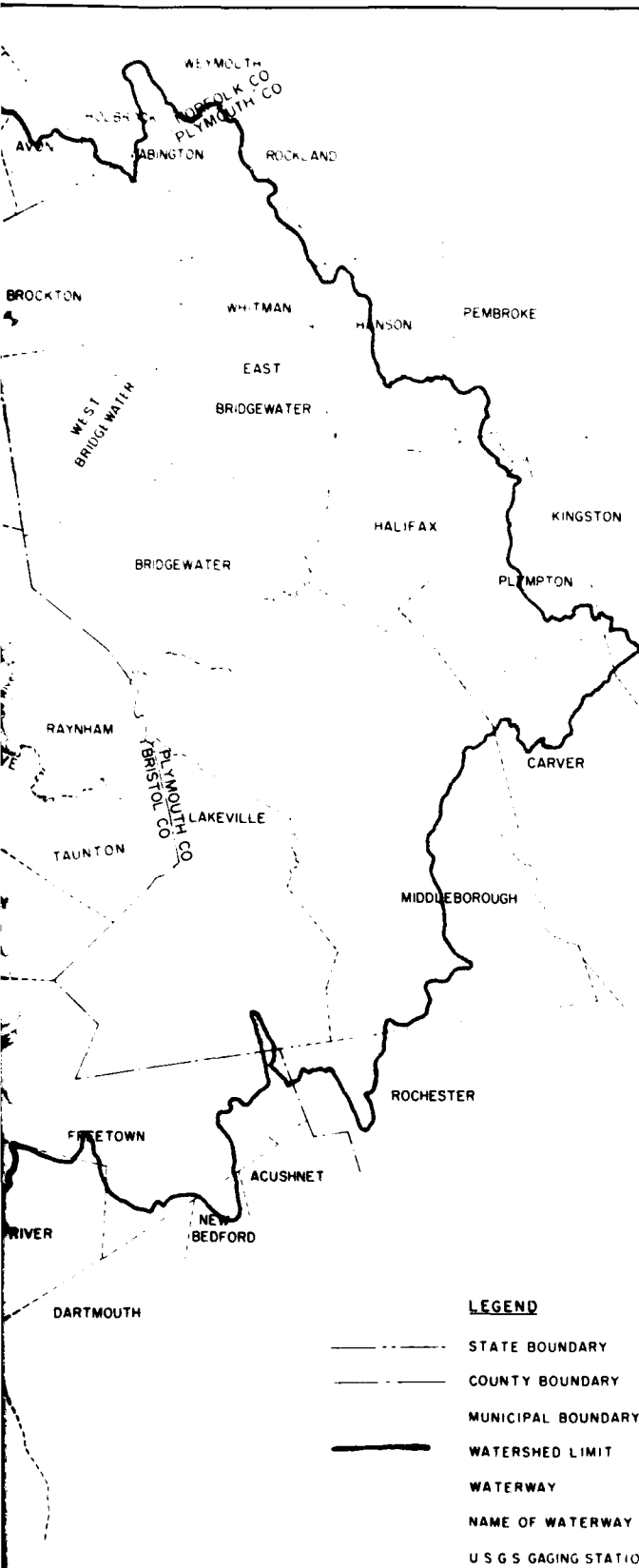
TABLE D-7
UPSTREAM EFFECT OF DRAWDOWN
AT TAUNTON BARRIER

WATER SURFACE ELEVATIONS
AT CONRAIL R.R. BRIDGE
RIVER STA 85190+

Drawdown at Barrier(ft)	100 Year Flood Q = 10,000 c.f.s.			1968 Flood Q = 8,400 c.f.s.		
	NAT	With Drawdown	Δ (ft)	NAT	With Drawdown	Δ (ft)
	11.86	-	-	9.94	-	-
2	11.86	10.27	1.59		8.32	1.62
4	11.86	9.12	2.74		7.38	2.56
6	11.86	8.31	3.55		6.83	3.11
8	11.86	7.89	3.97		6.53	3.41
10	11.86	7.76	4.10			

Note: Δ is the difference in feet between the computed natural and the modified water surface elevations for various drawdowns at barrier.





WATER RESOURCES MANAGEMENT REPORT
 TAUNTON RIVER BASIN
 MASS. - R.I.

**LOCAL PROTECTION
 PROJECTS INVESTIGATED**

DEPARTMENT OF THE ARMY
 NEW ENGLAND DIVISION, CORPS OF ENGINEERS
 WALTHAM, MASS.

2

CORPS OF ENGINEERS

A

B

C

D

E

1

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1

U. S. ARMY

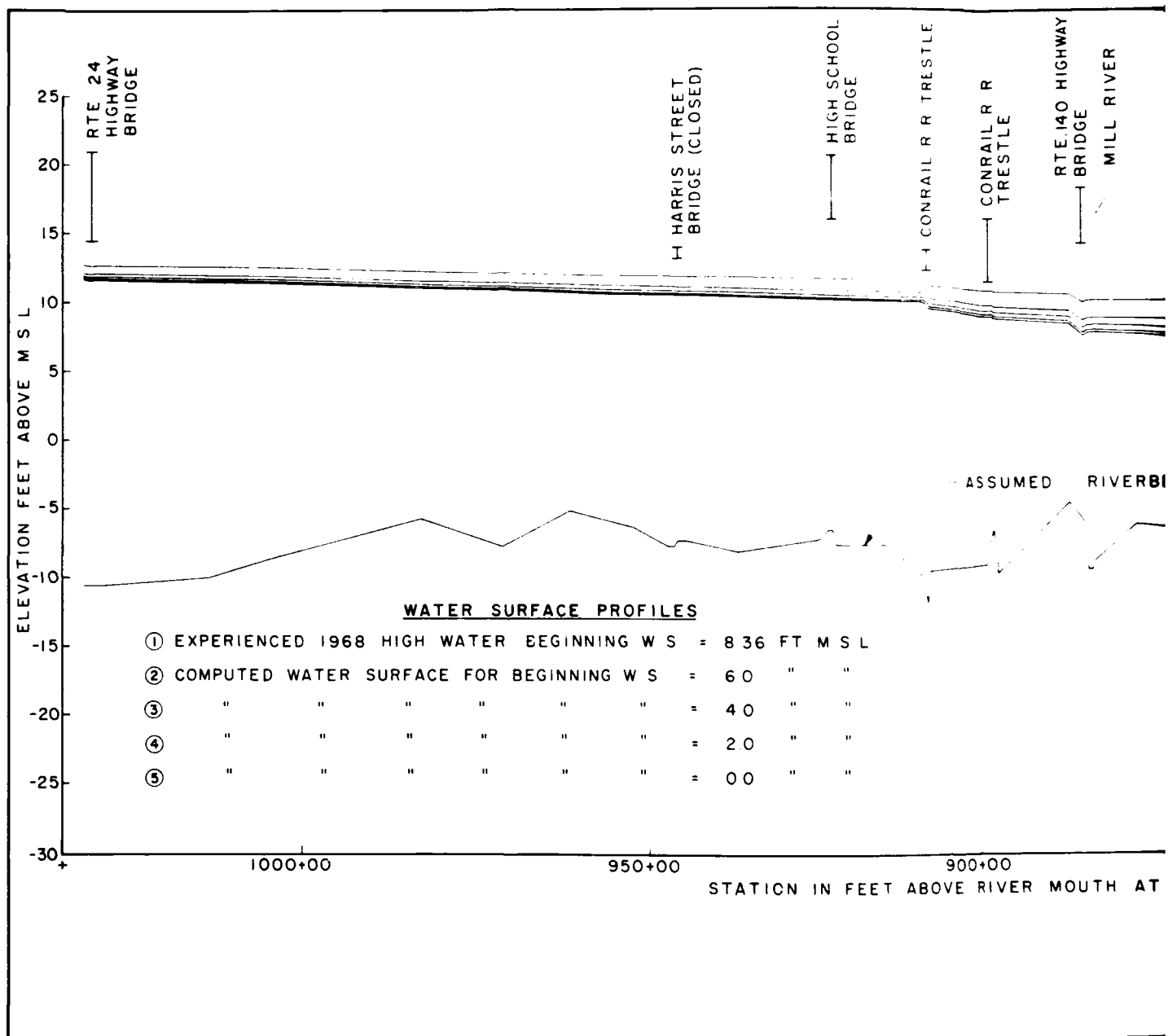


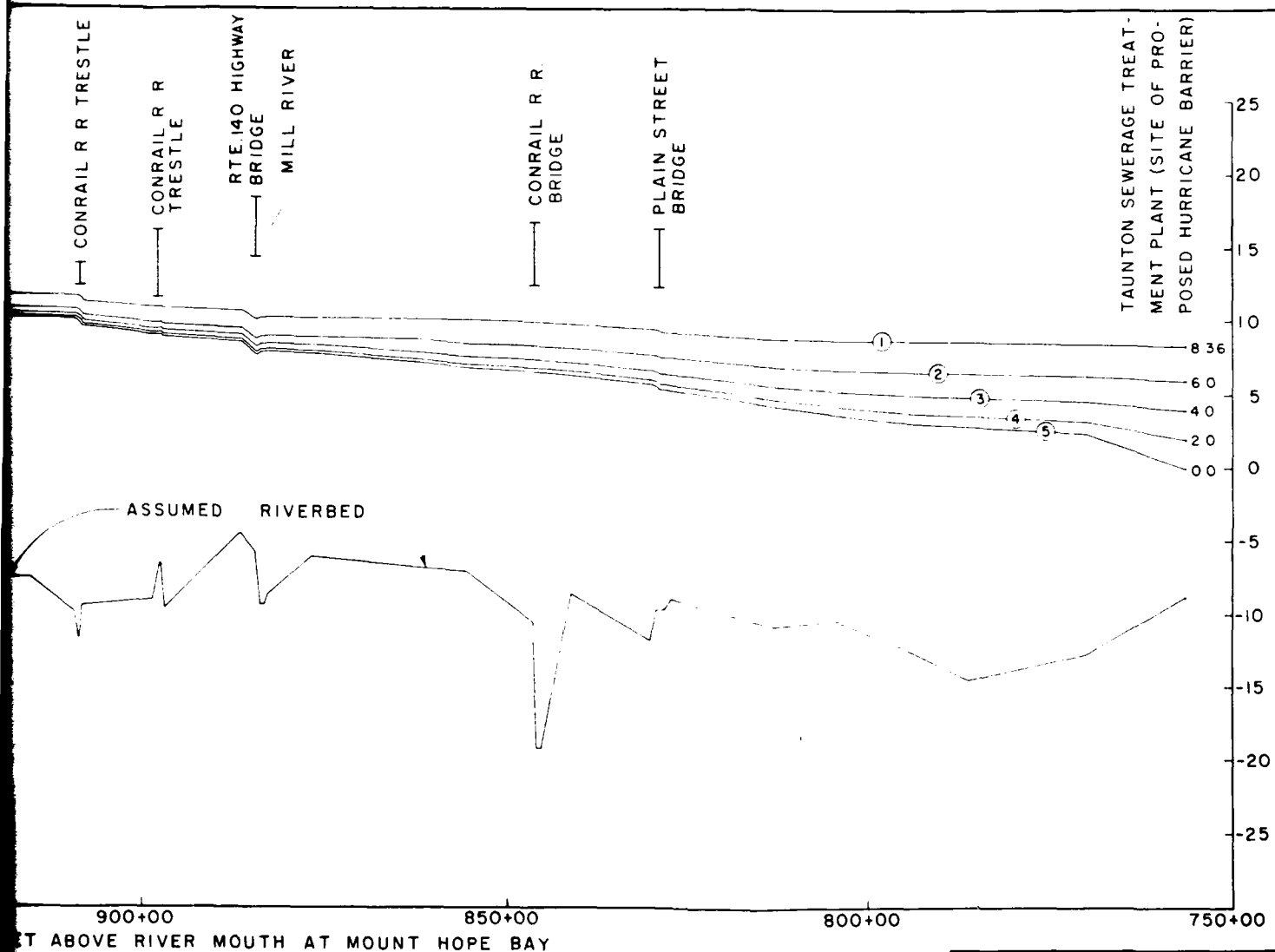
WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS. - R.I.

TAUNTON HURRICANE BARRIER

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS

PLATE D-5





900+00 850+00 800+00 750+00
 FT ABOVE RIVER MOUTH AT MOUNT HOPE BAY

SCALE HOR 1" = 1000 FT
 VER 1" = 5 FT

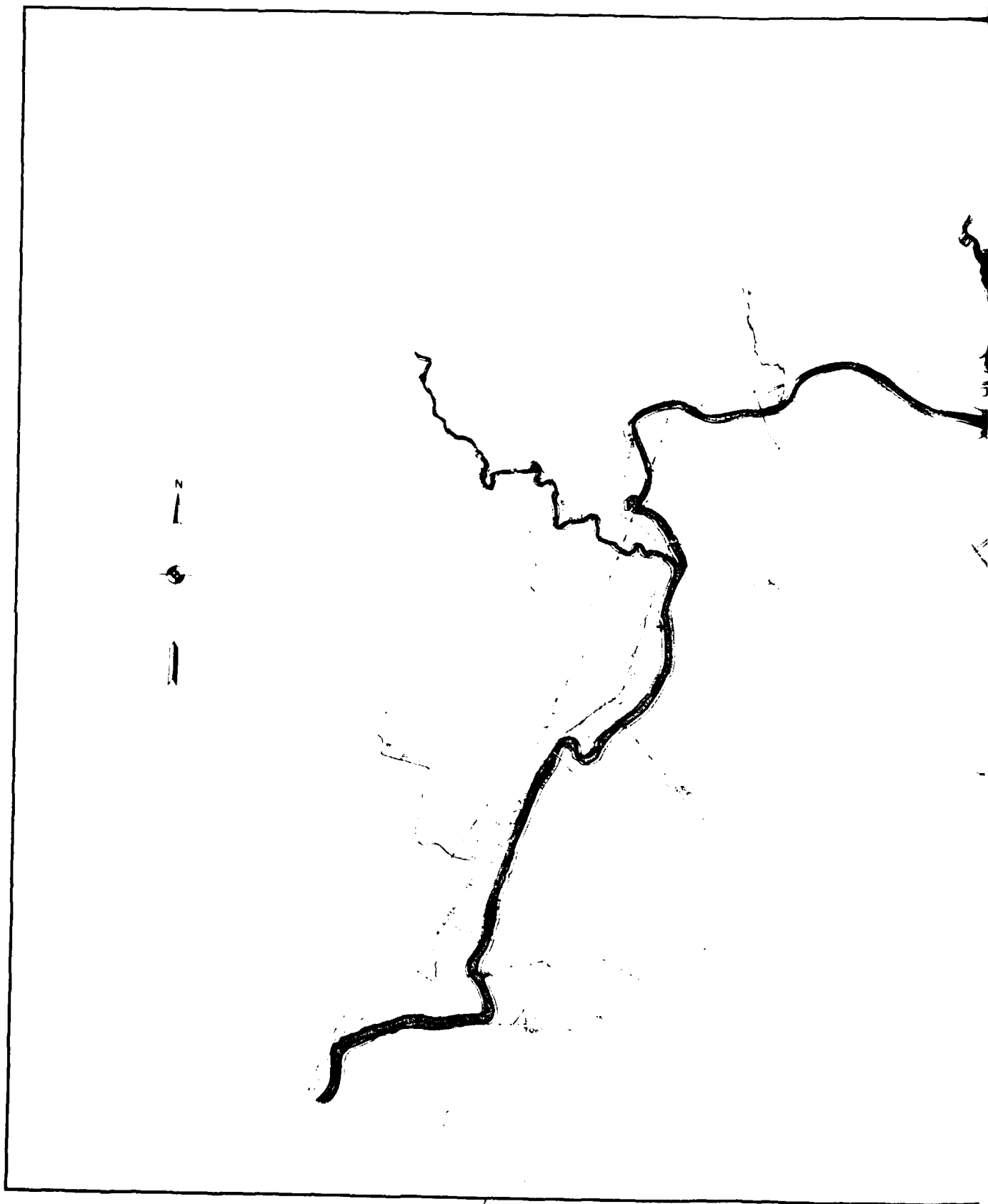
TAUNTON RIVER BASIN
 TAUNTON RIVER

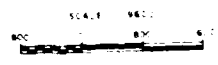
W. S. PROFILES

TAUNTON R MASS

SEPT 1977

PLATE D-6





ACKNOWLEDGEMENT GIVEN TO
THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC AFFAIRS
HYDROGRAPHIC MAPS

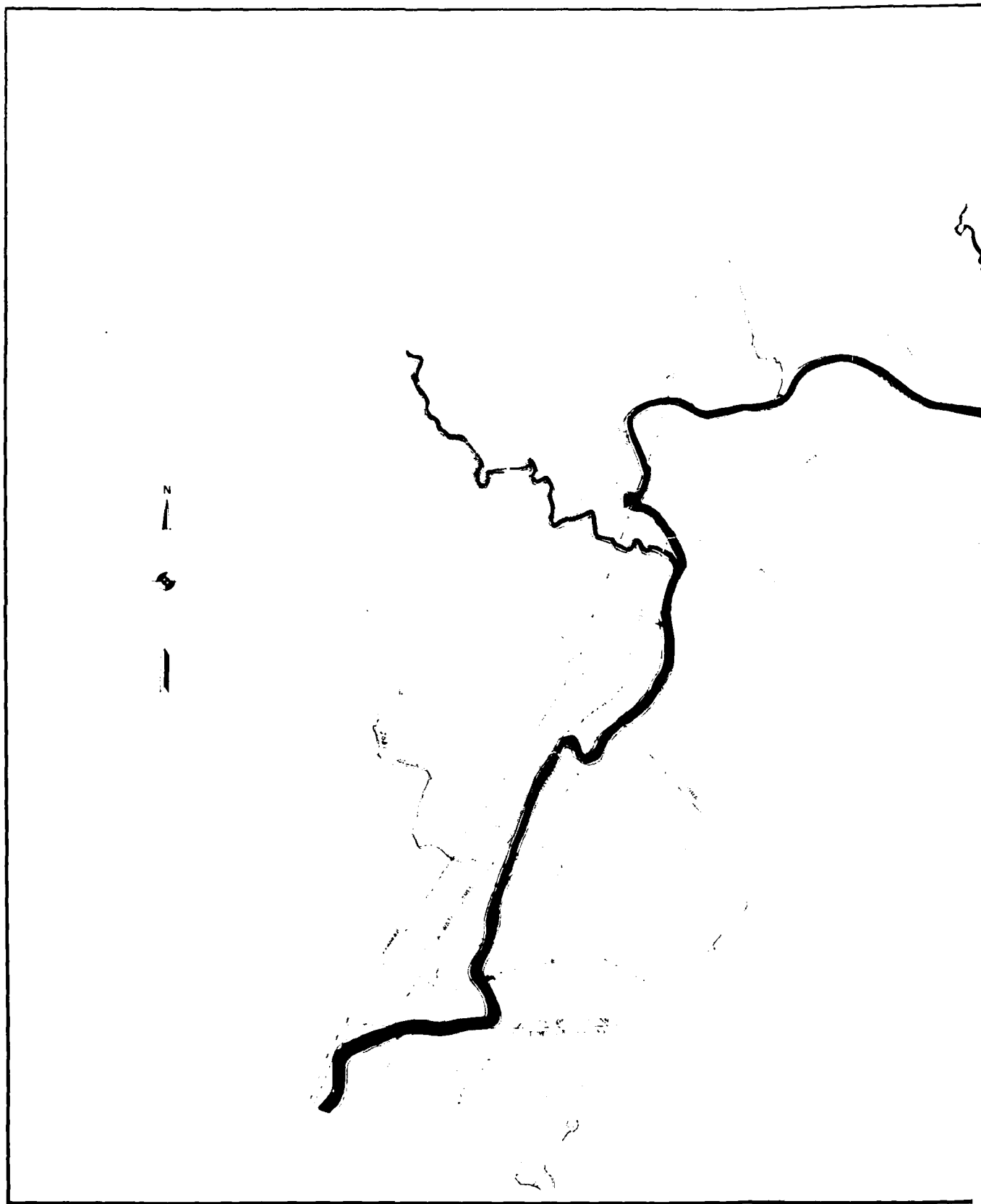
WATER RESOURCES MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R I

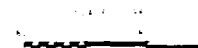
AREA PROTECTED BY BARRIER
AT THE APPROXIMATE 100 YEAR TIDE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS

PLATE D-7







STATIONARY POINT OF THE
THE TOWN WATER TO THE SEA AT THE
THE TOWN WATER TO THE SEA AT THE
THE TOWN WATER TO THE SEA AT THE

WATER MANAGEMENT REPORT
TAUNTON RIVER BASIN
MASS - R I
AREA PROTECTED BY BARRIER
AT THE APPROXIMATE SPH TIDE

WATER MANAGEMENT REPORT
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MASS - R I

SECTION E

The Selected Plan

THE SELECTED PLAN

All of the structural measures investigated for Federal implementation in the Taunton River basin proved to be economically unjustified. Solving the numerous local drainage problems is not the intent of this study. The only measures that can be recommended are the nonstructural or regulatory types. These should be twofold. First, the major wetland areas listed on Table B-2 should be preserved both by enforcement of the Commonwealth of Massachusetts Wetlands Act and administration of the 404 Permit Program of the Corps of Engineers. The Commonwealth has spent considerable funds in acquiring the Hockomock Swamp. This can assure that increased flood problems in downstream reaches to the Town River will not occur as long as new development is kept out of the floodplains.

The second and equally important flood management recommendation is the adoption at the community level of appropriate and equitable floodplain zoning. The Federal Flood Insurance Program under Flood Insurance and Hazard Mitigation Office of the Federal Emergency Management Administration (FEMA) as presently administered serves as a strong stimulus for the adoption of floodplain zoning. The HUD program also provides assistance through the delineation of flood prone areas. Numerous towns in the Taunton basin are presently being studied for flood prone delineation. These towns are listed on Table A-1. Only the latter of the two recommendations is applicable to the tidal communities of the lower basin. For these communities it is most imperative that they prohibit new growth in the flood-prone areas.

Future consideration for acquisition of swamplands by non-Federal interests should be considered by either State or local governments. No wetlands are warranted for acquisition by Federal interests as all alternative plans lack the required economic justification. Some of the more critical wetlands that should be preserved are the systems along the Canoe River in the Mill River subwatershed and the Hemlock-Chartley Brook swamps in the Threemile subwatershed. Areas downstream of these swamps are somewhat developed. Should these swamps be drained and built upon, some increases in annual damages could result.

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